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OUR COAL AND OUR COAL-PITS;

THE

PEOPLE IN THEM,

AND

THE SCENES AROUND THEM.

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BY A TRAVELLER UNDERGROUND.

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LONDON:
LONGMAN, BROWN, GREEN, AND LONGMANS.
1853.

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PREFATORY OBSERVATIONS.

In this little, but rather laborious work—laborious, in part because it is little—will be found a compendious natural history of Pit-coal and Pit-people. I have attempted to supply a want long felt—namely, a popular and brief notice of all that is connected with coal. The reader will, I hope, be pleased to be told where coal is found—of what it is composed—how it was deposited, and how it lies in the earth; how it is reached—how it is obtained, and how brought to market and to his grate; what a great colliery establishment comprises—at what cost capitalists engage in it—what are their hopes, defeats, and profits; what appearance the great Newcastle coal district presents; how the metropolis of coal arose; how the coal is shipped when it has been extracted; how the rivers became coal-carriers; how the surrounding scenery is affected by this trade; how men of various grades thrive upon coal in various ways; what kind of place a deep northern coal-pit is; what you see before you go down, how you go down, what you behold and feel when you are down, and what you look like when you come up; what sort of people the pitmen and pitboys are; what opinion the author formed of them, and what information, of varied interest, he elicited from them; what he thought and learned of their manners, and customs, and morals, and religion, or irreligion; their lives and their deaths—natural or accidental.

To all these particulars the author has added a few brief notices of pitmen's wives and children—learning and literature—"strikes" and grievances—homes and haunts—economy and education. Finally, he has appended to the above a sketch of one or more eminent men, who, once being pitmen, have gone down lower, and afterwards risen higher than most other men. I believe the reader will now acknowledge that it is impossible to get much more out of a coal-pit.

Some novel-spoilt readers will perhaps say, they don't want so much about one thing, and that one thing *Coal*. But if they will patiently peruse this book, they will find that I have carefully constructed it to contain a little of many things, and all very good and useful things. They will herein learn a little geology (and not a little, though comprised in a narrow compass), a little topography, a little engineering, a little building, a little mining, a little commerce, a little on education, a little on cottage economy, and a little biography. What more could you hav[illegible] variety, and in the shape of information—all [illegible] pit?

[illegible]ake credit to myself for some novelty. When [illegible], now several months ago, I had long thought [illegible]hing like it had been before attempted. I [illegible]r and cheap literature of the day, and found [illegible]w short articles and sketches in periodicals, [illegible] knew the writer intimately. The only de[illegible]tative information were certain folio books, [illegible] Books." In these there is nothing very [illegible]s are neither very readable nor very reach[illegible] people they are a dead letter, and to the [illegible] dead weight. They have this peculia[illegible]lly contain very much that you do *not* want, [illegible] *do* want, and that little hard to find.

I must add, if I may speak more particularly of myself, that what I here describe is not the result merely of pen and ink, but also of pedestrian labours. It is very fashionable now-a-days to travel above ground, but very few, like the author, have travelled much underground. In that part of this work relating to subterranean scenery, I describe what I myself have seen and experienced. I chiefly confine my descriptions to the great North of England Coal-field, because no other is equal to it in commercial importance, or in mining magnitude.

The Tyne and the Wear, and their adjacent collieries, are personally familiar to me. On the Tyne I have visited *thirty-one collieries* for personal examination, and several others on the Wear river. I do not want to boast how often and how far I have been underground; but certainly quite often and far enough for the reader's profit and entertainment, and for my purpose, peril, and fatigue. As to how *deep* I have been underground, let me here say, what I shall repeat in the work, that I have been as deep underground, in one descent, in one shaft (near Sunderland), as the monument of London would be if *piled seven or eight times upon itself*,* and more than as deep as St. Paul's would be if it were piled upon itself *three and a half times*. Moreover, that same shaft was equivalent to a chimney, and a foul one too; for the impure air of the mine escaped from it, after passing over a roaring furnace at the bottom, as I descended. One more remark on this matter, and I pass on. I find by my note-book, now lying before me, that twelve shafts which I descended make, in the aggregate of their depth, *eleven thousand seven hundred and eighty feet*. I infer that I shall now be considered *profound* enough.

* The monument is said to be 202 feet high. St. Paul's is given as 340 feet high. The Monkwearmouth shaft is, accurately, 1590 feet clear perpendicular depth.

Travels of this kind being singular, I suppose some of my friends will recognise me. It is not my desire they should do so, as I wish no pit glory. It is more than any one of them would have done if they had seen me coming up the pit, after a long subterranean sojourn, in full pit costume, with stick in hand, pit-cap on head, and pit-dust all over. Indeed, when I have stood before the glass after such a journey, I have found no motive for vanity; and it might then have been said of me—

> He was a man as black as any other,
> And though warm water wash'd away the stain,
> When ask'd, "And is that you now or your brother?"
> Replied—"'Tis neither—till I'm clean again!"

THE AUTHOR.

PITVILLE, *February*, 1853.

OUR COAL AND OUR COAL-PITS, &c.

COAL AND GOLD.

THERE are two words, each containing only four letters, but expressive of the two most valuable minerals in the world—COAL and GOLD. No two minerals are more valuable, none more opposite in outward appearance. The one is bright and dazzling, the other black and forbidding. The one the [illegible] light, the other every man's com[illegible]. The one is [illegible] banks and bank-cellars, the othe[illegible] [illegible]. The one soils the mind of him w[illegible] soils only the face and fingers of [illegible]. The one is the apparent represent[illegible] the other its real representative.

At the time the author is writ[illegible] sailing to the gold diggings at th[illegible]. The gold diggings are at home under our fee[illegible] is coal; and if all our coal were rep[illegible] taining gold diffused through them[illegible] by the exchange. Upon reflectio[illegible] mines of the precious metals were [illegible] gings of gold were at once exhaust[illegible] brief, if gold and silver were no [illegible] society would, after certain evolutio[illegible] ing other representatives of value, g[illegible] hand, let civilized communities be [illegible] is difficult to see how they could h[illegible] only should we, with the loss of c[illegible]

maintaining healthful and equable warmth in our cottages and palaces, our halls and our domiciles, but we should lose all those numerous and remarkable benefits which the application of coal to scientific purposes procures for us. It is common to depict the advantages introduced by the steam-engine, and to say that it weaves, it spins, it pumps, it prints, it winds, it draws, it stamps; and, in fact, does all that steam-moved machinery can do. But what enables the steam-engine to do all this?—*coal*. All the skill of Watt* would have been in vain without supplies of mineral fuel.

Without coal, no longer would our favoured country be the great factory for supplying the necessities of the great family of mankind. Deprive us of our coal, and no longer should we, by our commerce, convey the conjoined benefits of knowledge and civilisation to the remote regions of the globe. No longer should we all but triumph over time and space—no longer traverse the land with a rapidity which has exceeded all anticipation —nor the ocean with a swiftness and certainty which brings the far East, or the New World itself, within the voyage of a few days. Without coal our steam-power would be annihilated, and with that, our prosperity as a nation, and possibly our supremacy. Our steam-engines would rust unused, for lack of suitable fuel; our factories would be closed; our railroads would be untraversed; our steam-vessels would be dismantled, and decaying in dock, and all our processes of manufacture would be deteriorated; and the future historian of the revolutions of empires would date the decline and fall of the vast dominion of Britain, from the period when her supplies of mineral fuel were exhausted, and her last [illegible] worked out!

[illegible] a picture of the exile Marius, [illegible], and musing and mourning in [illegible] has drawn an equally striking [illegible]ting and musing on the ruins

[illegible] in motive powers, still coal will, in all [illegible] Should Ericsson's Caloric Engine be- [illegible] quantity of fuel (to about one-tenth [illegible]way with coal altogether.

of London, at the debris of the fallen St. Paul's. It has been reserved for the author of this book to conceive the picture of some one of his lineal posterity sitting on the top of the ruins of a great, but exhausted Newcastle colliery, and mourning and moralizing over the fate of fallen Britain! Should such a picture ever be drawn, its subject will be more pathetic and powerful than that of proud Marius, or the feathered New Zealander!

Should any one confidently suggest the introduction of *gas-fires*, like to that lately exhibited at the Polytechnic Institution, we would only say, where is the gas to come from except from coal? and, if the coal be exhausted, will not the gas be likewise? Again, only imagine one piece of dissatisfaction arising out of the use of gas-fires in houses. There would be no poking of the fires; and every body knows how many pleasures of a peaceful home this poking of the fire brings with it, not to mention the many little family discourses which such poking puts an end to. For himself, the author is free to confess, that his wife's society would not always be so agreeable if he could not poke the fire; and if *she* could not poke the fire, then *he* himself, might sometimes be poked instead." Coal, then, is no less a promoter of domestic peace than of national prosperity.

The extent of the coal-fields in Great Britain is said to be 4251 square miles, and the consumption is stated to be 23,000,000 of tons per annum. It has been computed at 22,700,000 tons, exclusive of the coal consumed in the manufacture of hardware and cutlery. If coal costs the consumer an average price of 7s. per ton; then 22,700,000 tons will be worth, in all, nearly £8,000,000 sterling per annum. Mr. M'Culloch estimated the total number of persons employed in the work of collieries in Great Britain, at from 160,000 to 180,000; and that the total capital employed in the British Coal Trade is no less than £10,000,000 of money.

CONSEQUENCES OF CONTIGUITY TO COAL-FIELDS.

Contiguity to coal-fields has exercised a far more important effect on cities and towns than most men would expect. Take

only one example, that of the small central coal-field of England. Its area scarcely equals that of the larger Scottish lakes, and yet that limited coal-field has made Birmingham a great and flourishing town—the first iron depot in Europe; and it has filled the surrounding country with crowded towns and villages. Think only of what the coal from the Staffordshire coal-field has done—how many thousand steam-engines has it set in motion—how many thousand railway trains has it propelled across the country—how many thousand waggon-loads of salt has it elaborated from the brine—how many million tons of iron has it furnished, raised to the surface, smelted, and hammered! Think farther, to what ultimate and opposite purposes this coal has converted its manufactures. Walk down a certain street in Birmingham, and you hear volleys of sharp reports from guns *proved* by extra charges of powder. Some say a gun a minute is made in Birmingham; that is one result of the coal. Then look you on those grosses of steel pens, piled up in grosses of little boxes, about to slip into the hands of editors, authors, divines, novelists, poets, lovers, the bereaved, the good, the bad, the merchant and his fifty clerks, the banker and his hundred clerks, the bank of England, the innumerable minor banks, the assurance offices, the warehouses, the customs, the government offices, the palace; and finally, though most important of all to you, gentle reader, just now——into the hands of the author of this work!

And all this only out of guns and steel pens. What, then, shall not still come forth from the Staffordshire coal, when we begin to think of the multitude of useful and ornamental "Brummagem goods" which fill the toyshops and the dwellings of the civilized world? Think only of the costly and countless articles of this character that appeared in the Crystal Palace. Remember the productions of the great houses of Birmingham, of the houses of Chance and Co., and others. Call to mind every thing, from a glass ornament, a gilt or silvered plate service, a gun barrel, down to a gilt button, and *all* come from the Staffordshire coal! I go not to Wolverhampton, I pass not to the great Staffordshire iron-works, I stop not at the Smethwick iron-works,

where Fox, Henderson, and Co. have erected a fortune and a colony out of and upon the Staffordshire coal; but I stop in the very town of Birmingham itself, and when I have at length succeeded in grasping the idea of the entire possible products of this well-employed coal, I say that is the *true Philosopher's Stone*—it is discovered at last. Not one of all Father Newman's questionable miracles, not one of the numerous marvels which he details of the saints, in the Popish Cathedral at Birmingham, not all of them together can equal the accredited and unquestionable marvels of *Coal*. Let all the saints named in "Butler's Lives of the Saints," rise up again, and unite their marvel-working powers, and one ton of coal will beat them all! Let the saints walk, after decapitation, with their heads comfortably under their arms—let them cross seas on their outspread mantles—let them call up plagues on heretics, and call down blessings on priests; see visions of virgins, and dream dreams of St. Dominic and St. Francis; the whole of these saintly dreamings are every day surpassed by the realities of the results of coal at Birmingham. One day's *guns* will plague the heretics more than a thousand saints. One box of steel pens will conjure up more visions before a thousand eyes, and that for year after year, than all that Eremites and Anchorites ever beheld in cave, or cell, or chapel. Dr. Wiseman, let the author tell you a secret (not under seal of confessional secresy); your greatest enemy is not the Archbishop of Canterbury, nor Dr. Achilli, nor Judge Campbell, but COAL! Coal, for what it originates—from steel-pens to steam-printing presses—*Coal is the Protestantizer of England!* If one small coal-field has effected so much in one town, what may we not expect, or our posterity, from those vast basins shown by Lyell in the geological map of the United States? Glancing over the three huge coal-fields of the States, each surrounded by its ring of old red sandstone, like patches of bitumen floating on their clayey pools, we may call to mind the prophecy of Berkeley as to the westward course of empire. Some of the numerous coal-fields of America are equal in extent to all England; and their dark seams inlay the landscape as with ebony, and impart to it its most striking peculiarity of feature. If a patch of a few square

miles has done so much for central England, what may not fields containing many hundred square leagues do for the United States?

PRODUCTS OF PRINCIPAL COAL COUNTRIES.

The subjoined table of the comparative productions of the six principal coal countries in the world, in the year 1845, will be interesting in many respects.

TABLE OF COMPARATIVE PRODUCTION OF MINERAL FUEL.

Order in 1845.	Countries.	Square Miles of Coal Formation.	Tons of Fuel raised in Year 1845.	Relative parts of 1000.
1	Great Britain ...	11,859	31,500,000	642
2	Belgium.....	518	4,960,077	101
3	United States ...	133,132	4,400,000	89
4	France	1,719	4,141,617	84
5	Russian States ...	Not defined.	3,500,000	70
6	Austrian States...	Ditto.	659,340	14
Totals.....		...	49,161,034	1000

Thus will be seen at a glance to what Great Britain owes her chief prosperity. No nation, however favourably situated in other respects, if not plentifully supplied with this invaluable mineral, can hope to rival nations that are so supplied—at least, in most branches of manufacturing industry. To what is the astonishing increase of Glasgow, Manchester, Birmingham, Leeds, Sheffield, and, above all, Newcastle-on-Tyne, to be attributed, but to the presence and working of coal? And to what can the comparatively stationary or declining state of Canterbury, Winchester, Salisbury, and the other towns in the south of England, be ascribed to, but to the absence of coal? The more you consider it, the more you will be inclined to believe, that the abundance of coal in the north, and its scarcity and consequent high price in the south of England, is the real cause of this striking and increasing discrepancy.

This will be still more strikingly displayed in our remarks further forward, on the wonderful increase and advancement of Newcastle-on-Tyne.

There is the highest interest to be found in the account of Cortes' conquest of Mexico, and of Pizarro's conquest of Peru. But, had Great Britain gained Mexico, or Peru, or the Great Mogul Empire, and lost her coal-fields, she would have been greatly impoverished by the exchange. Alter the lines of Shakspeare, to express this poetically, thus: let Great Britain say,—

> Who steals my gold steals trash,
> But he who steals my *coal*, steals that
> Which much enriches him, but makes
> Me poor indeed.

Or, let me just quote a stanza of my own—

> Let foes but steal our cash, and then
> They leave us what we were—brave men.
> But could they filch our mines of coal,
> They'd steal our bodies, selves, and soul.
> 'Tis COAL that makes our Britain great,
> Upholds our commerce and our state.

As regards the coal-fields of the world, though our own country is not that containing the largest amount of fossil fuel, (for the United States much exceed us in the amount possessed,) yet this is, at the present moment, the land in which the largest amount of coal is raised. The annual weight raised in this country, is now usually estimated as equal to 35,000,000 of tons, or—taking the ton of coal as equal to about a cubic yard—more than eleven square miles of a bed of coal three feet thick, supposing the whole of the coal removed.

Of this large amount, about 2,728,000 tons are exported, leaving the remainder, 32,272,000 tons, for domestic and industrial consumption; the portion devoted to industrial works being largely employed for the smelting of our ores, and especially those of iron. The annual produce of our collieries may amount to 35,000,000 tons on the whole.

NUMBER OF BRITISH COLLIERIES, AND THEIR PRODUCE.

The statistics of coal and collieries in the united kingdom are not authentically given, and we are left to individual estimate and conjecture; therefore, to ascertain the number of collieries is a matter of much difficulty, and indeed can only be approximated to in the following manner.

It is generally admitted by good authorities, that the total annual production of coal in Great Britain does not exceed 35,000,000 tons, and this is by some supposed to exceed the annual actual consumption. Assuming it, however, as correct, and presuming that there are 300 working days in the year, if there were 12,000 collieries, each mine would only produce nine and a half tons per day; whereas 800, 500, 200, and 100 tons per day are ordinary productions, and even in small collieries fifty tons per day are produced. Taking the collieries throughout Great Britain, seventy-five tons per day may be taken as a fair average production from each mine, and this would make the number of collieries only 1511. Thus, Mr. Braithwaite Poole affirms that there are 12,000 collieries in Great Britain, and Mr. Dunn, a government inspector, estimates the number of coal-mines in his district of inspection at 2000. Now, I am confounded at such statements; for even if I take fifty tons of coal only as the average quantity raised in each mine, then the number of collieries in England, Wales, and Scotland, is only 2266. I believe that the whole number of British collieries does not exceed 2000, I mean, of course, working and valuable collieries. Now, taking 2000 as the number of collieries, these, if equally divided amongst the four government inspectors, will leave 500 under the charge of each. Each inspector may inspect (efficiently and on average) three in a week, and it will then take him *three years* to inspect all the coal-mines under his superintendence. If we had, as Mr. Dunn unaccountably says *he* has, 2000 collieries under his inspection, then he would take *twelve years* to inspect his collieries efficiently!

AREA OF BRITISH COAL-FIELDS.

By careful computation from the Ordnance maps, and other Geological maps, and the corrections of personal knowledge, the following table is constructed :—

AREAS OF COAL-FIELDS IN THE UNITED KINGDOM.

ENGLAND AND WALES.

Districts,	Areas in Square Miles.
1. Northumberland and Durham	840
2. Cumberland (West)	96
3. Yorkshire	964
4. Lancashire	308
5. Cheshire	90
6. North Wales	160
7. Shropshire	75
8. Staffordshire	302
9. Warwickshire	105
10. Forest of Dean	35
11. Gloucestershire and Somersetshire	48
12. (Derbyshire* conjectured 190,000 square acres.)	
13. South Wales	1945
Total for England and Wales	4068

SCOTLAND.

A great coal-field extends from Cupar and Dalkeith on the east, to Irvine and Ayr on the west coast, with interruptions	1700
Total for Great Britain	5768

IRELAND.

1. The Shannon coal-field	1408
2. Kilkenny (South)	126
3. Kilkenny (North)	205
4. Dundalk	49
5. Sligo	307
6. Dungannon	32
7. Ramoan	10
Total for Ireland	2227
Grand Total for the United Kingdom	7995

* As there is some doubt of Derbyshire, it is excluded from the total.

SUMMARY OF THEIR LOCALITIES AND CONTENTS.

We may naturally classify the coal-fields of England and Wales under three general districts:—

1. The great northern district, including all the coal-fields north of the Trent. 2. The central district, including Leicester, Warwick, Stafford, and Shropshire. 3. The western district, subdivided into north-western, including North Wales, and south-western, including South Wales, Gloucestershire, and Somersetshire.

The total thickness of coal in the English coal-fields is generally about fifty or sixty feet. This total is in most districts divided into twenty or more beds, each varying from six feet to a few inches thick; and it alternates with from twenty to fifty or a hundred times as great a quantity of sandstones and shales; which deposits are the most variable portions in all coal tracts, the most regular being the coal beds and ironstones.

I average the total thickness of this mass of alternating strata, which is collectively termed *the coal measures*, at 1000 feet, which is about its amount in South Staffordshire; but the difference is very considerable in all the coal-fields. Let us regard more particularly some of the principal English coal fields.

The great coal-field of Northumberland and Durham is in many respects the most interesting in the whole world; at least it is so to Londoners, who have been until recently warmed almost exclusively by its produce. The beds of the coal-measures are eighty-two in number, and consist of alternating beds of coal, sandstone, and slate-clay; making an aggregate thickness of 1620 feet, which, however, varies in different parts. It is a very difficult matter to enumerate the distinct beds of coal in this mass, but they probably amount to between thirty and forty. The aggregate thickness of the whole number of seams is about forty-five feet; but there are eleven seams which, on account of their thinness, are not workable. The two most important beds are called the High Main and the Low Main, the latter being situated about 360 feet below the former, and the thickness of each averaging about six feet.

The extensive coal-field which ranges through South Yorkshire, Nottingham, and Derbyshire, is closely allied in character to that of Newcastle, and is considered by some geologists to be a re-emergence of the same strata from beneath the covering of the magnesian limestone, under which they suppose it to be concealed through the intervening space. It extends a little from the north-east of Leeds nearly to Derby, a distance of more than sixty-five miles. Its greatest width, twenty-three miles, is on the north, reaching nearly to Halifax on the west. On the south it extends towards the east to Nottingham, and is there about twelve miles wide.

The strata of these measures range and dip as do those of the Newcastle coal-fields. The number of seams or beds of coal is about thirty, varying from six inches to eleven feet, and the total thickness of coal about eighty feet.

The Manchester or South Lancashire coal-field, is separated from the last described by a lofty range of hills. It commences in the north-west of Derbyshire, and continues thence to the south-west part of Lancashire, forming an area somewhat in the shape of a crescent, having Manchester nearly in the centre.

Numerous as the other coal-fields are, there is more than one-third of England in which all search for valuable coal is useless.

The South Staffordshire or Dudley coal-field, so important for the extensive iron-works which it maintains, is in length about twenty miles from north to south, and in greatest breadth about seven miles. Its superficies, from actual survey, is about sixty square miles. One portion of it is distinguished by the presence of one continuous bed of coal thirty feet thick, termed the main or ten yard coal, which is made up of thirteen different beds of coal, some lying close together, others separated by thin bands or partings of shale.

The carboniferous limestone and the old red sandstone are entirely wanting beneath this coal-field; and this circumstance is considered to indicate the accumulation of the coal strata of Dudley, in a fresh-water lake. They rest on the upper members

of the Silurian system, viz., the Ludlow rocks and the Wenlock limestone.

WHAT COAL IS, AND ITS VEGETABLE ORIGIN.

It is now generally admitted that coal is the product of decomposed vegetable matter; and that there are two hypotheses as to the mode in which it was brought together, in such vast quantities as we now find it stored for man's benefit. Deluc, Brongniart, Dr. Macculloch, and Mr. Hutton of Newcastle, think that the plants from which it was formed, grew and died on the spot where the coal exists, and that a bed of coal was analogous in its origin to a peat-bog. The other hypothesis (which is received by many geologists) assumes, that the vegetable matter was swept from the land into estuaries or lakes by inundations and streams; as the trunks and brambles of trees, with plants and foliage, are carried down by the Mississippi and St. Lawrence in North America. This latter is called the *drift theory*. The difficulty of accounting for the immense accumulations of vegetable matter spread over such extensive areas is great in either way. I do not here decide on the correctness of either theory. The following observations as to the vegetable origin of coal, are applicable upon either supposition. I assume the certainty of the vegetable origin of coal. Indeed, it is now almost universally accepted.

Coal was analogous in its origin to modern peat, and each bed was most probably formed on an extended surface of marshy land, covered with a rank and luxuriant vegetation. Mr. Hutton considers the finest caking coal to be a crystalline compound, whose constituents had been in a state of solution; but slate coal and cannel coal often bear distinct impressions of plants. The new method of cutting minerals and fossils into slices so thin as to be transparent, and of which Mr. Witham of Lartington has made so happy a use, has been applied to coal. By examining these slices with the microscope, the vegetable structure has been detected where no external trace of it was visible. In cannel coal, such as is found at Wigan in Lancashire, the vege-

table structure exists throughout the whole mass, while the fine coal retains it only in small patches, which appear, as it were, mechanically entangled. Mr. Witham has discovered very regular texture in one variety from the roof of a seam in Northumberland. The tissue is seen only in patches, but it exactly resembles that of the recent *Coniferæ*, and of the fossil genera *Pinites* and *Pinus*. There are regular series of roundish, or sub-hexagonal cellules, separated by opaque spaces, which seem to be obliterated medullary rays.*

From these and other indications of ligneous origin—(such as minute tubes filled with a yellowish resinous matter, which is the most volatile part of the coal, being that which is first driven off by heat)—we consider that all coal has originally existed in the state of plants or trees. The fossils which have been found in the coal strata, especially in the northern district, are very strong evidences of this fact. A magnificent collection of these belonged to Mr. Hutton at Newcastle, who kindly went over them with me.† Many of them are engraved in Lindley and Hutton's *Fossil Flora*—a splendid work, which every one who wishes to see the vegetable produce of coal-pits, should peruse. The *Penny Cyclopædia* also contains a good article on coal plants. About three hundred species have been found in the sandstone and shale of the coal measures, and the greater part of these probably exist in the coal itself; although the tenderness and opaqueness of the material render it difficult to detect them by examination. The three hundred species are all extinct.

About two thirds of them are ferns. The others consist of large *Coniferæ* (allied to the pine), of gigantic *Lycapodiaceæ*, of species analogous to the *Cacteæ* and *Euphorbiaceæ*, and of palms. The coal plants indicate a moist climate, as hot as that of the tropics; and this holds true of the coal plants not only in English pits, but also at Melville Island, within the polar circle. Dr. Hutton thought that the vegetable had been carbonized by

* In my collection is a specimen of Bovey coal (a kind of imperfect coal or lignite), containing very minute *cones*, thus clearly evincing its origin.

† I hear Mr. Hutton has deceased. What has become of his invaluable collection of coal plants? The public feel interested in knowing their destination.

heat; but Dr. Macculloch contends on good grounds, that the change has been effected solely by water and pressure, and that by these agents peat is capable of conversion into coal. Under similar circumstances of moisture and pressure at present, vegetable matter is known to ferment, to produce spontaneous combustion, and to be consumed. If, for example, hay be stacked in a moist condition, or too closely packed, fermentation and ignition are produced, and the mass is consumed. If the process be interrupted, the hay is found to have acquired a dark-brown colour, a glazed or oily surface, and a bituminous odour. The same phenomena are observed in the case of flax, and indeed most vegetable substances.

Various experiments have been made, from which we learn, that if vegetable matter in a moistened condition be subjected to powerful pressure, so as to prevent its gaseous principles from escaping, bitumen, lignite, or coal, would be produced in the different stages of the process. Indeed, vegetable matter has been traced through every grade of the saccharine, vinous, acetous, and bituminous fermentation; and alcohol, ether, naphtha, petroleum, bitumen, lignite, jet, coal, amber, and even the diamond, have been referred to a vegetable origin.

In the coal, therefore, with which we warm ourselves, and by which we gain all the incalculable commercial advantages already glanced at—in this coal we have the forests of primeval times deprived of their watery and volatile parts, but preserving all their combustible matter, which is laid up, as it were, for our use in vast deposits under our feet, closely packed and protected from air, rain, and floods, by a solid covering of rock and soil. Few of those, I fear, who are in the daily enjoyment of the comforts and advantages derived from abundant supplies of this fuel, think of the long and obscure process by which it was prepared in the laboratory of nature. And not a few, I fear, will think the author a bore for attempting to make this subject interesting. But, if his patient readers will only accompany him as instructor through this little volume, what a fund of interest will they ever afterwards find in coal, and all connected with it. He hopes, he desires, as the height of his ambition, to live in

their recollections as the discoverer of a new pleasure where they would least have expected it—namely, in the very fireplace round which they may now be sitting, with this book in their hands!

GÖPPERT'S EXPERIMENTS ON FOSSIL PLANTS.

Any intelligent, and especially any botanical reader, would take an interest in the curious studies of a foreign professor, M. Göppert, himself a botanist, who has made some interesting researches, which illustrate our present subject—the vegetable origin of coal. In the coal of Silesia, and of other countries, M. Göppert has discovered, and obtained, several plants still flexible, and which admitted of his dissecting their epidermis, and organs of evaporation. Thus he has been enabled to ascertain how subterraneous combustion has destroyed the tissue in other plants found in the same formation. He detected, in what is called the *Keuper* formation, the branches of a tree analogous to the birch, on which the flowers and pollen were still perfectly preserved. Some fir-trees presented him with similar phenomena. It is well known that, in the north of Europe, there occasionally falls from the skies an enormous quantity of a yellow powder, which was once supposed to be sulphur, but which *savans* have pronounced to be the pollen of the fir-blossom. Now in Westerwald, Finland, Bohemia, and even in New York, this floral substance has been discovered in such great quantities, deposited between layers of earth, and mingled with fossil *infusoria* (microscopical animalculæ generated in infusions), that M. Göppert is enabled to pronounce that the antediluvian world must also have produced its enormous forests of gigantic pines, whose yellow dust could not but have obscured in its fall the light of day, since the masses of it are so thick and close pressed as even to raise the soil many feet.

Professor Göppert has endeavoured to imitate the agency of nature with remarkable success. Having observed that the leaf of ironstone nodules ("little masses"), might occasionally be separated in the form of a carbonaceous film, he placed fern-leaves in clay, dried them in the shade, exposed them to a red

heat, and thus obtained striking resemblances to fossil plants. According to the degree of heat, the plant was found to have become either brown, shining, black, or to be entirely lost, the impression only remaining: but in this latter case, the surrounding clay was stained black, thus indicating that the colour of the coal shales is derived from the carbon of the plants which they include. Some still more recent researches of the professor on the origin of coal, point more conclusively, if possible, to its vegetable derivation.

But, looking at the vast masses of coal stored up for us, what an enormous quantity of vegetation must have been necessary to produce it! Is there any kind of calculation which can be made to afford us some idea of this? I think there is, if we can devote attention to it.

SUMMARY OF GÖPPERT'S ESSAY ON THE FORMATION OF COAL.

In the year 1844, the Haerlem Scientific Society offered a prize for the following subject :—"To determine, by a careful examination of the various seams of coal, whether the beds of coal were formed entirely out of plants that grew on the spot, or whether they originated from vegetable matter floated from other places; and also to inquire whether different coal-beds have had a distinct origin."

At the meeting of the Society, on 23rd May, 1846, the prize was awarded to Dr. Göppert. This essay has now been published in a 4to volume, with twenty-two plates of the plants found in the shales and sandstones of this formation.

The following are very brief notices of some of the most important results of this essay, which ought to be translated into English:—

The first coal-works were opened about the year 1198, in Belgium; soon afterwards in England and Scotland; in the fifteenth century in France and Germany. The discovery of the coal-beds of other countries does not date further back than the close of the preceding century, and some even only from our own time.

Almost every quarter of the globe and every zone, including the polar zone, the southern temperate, and the tropical zones, are furnished with this mineral, Africa being the sole exception, unless possibly in Algiers.

Coal beds are wrought 1725 feet below the sea-level, and probably extend down to 20,656 feet; whilst they rise to 12,000 feet above it, and at Haranuco, in Peru, attain an elevation of even 14,700 feet.

Almost every where the formation exhibits a more or less basin-shaped form of stratification; and, so far as is known, a similar composition of alternating beds of coal, sandstone, and slate-clay, the first being the thinnest, amounting to from two to sixty, or occasionally as much as 120 feet in thickness.

Should we follow the views of many distinguished geologists, and feel justified in assuming, that after the deposition of the so-called *transition* rocks (the Cambrian, Silurian, and Devonian formation), Europe, or indeed the greater part of the earth, formed an immense sea, with a considerable number of separate islands, on which a tropical vegetation every where prevailed; then I conceive the origin of the coal deposits may be explained as follows:—

These islands, like similar spots in our time, had their mountains, valleys, rivers, and lakes: their moist and dry, cooler and warmer, shady and sunny localities. A tropical climate extended over the whole, as we may justly conclude from the vegetation, every where uniform in character, and only to be compared with that now growing within the tropics; for the fossil plants in both hemispheres appear every where identical, if not in regard to species, at least in the genera. *Stigmaria* is scarcely ever wanting, as well as *Sigillaria*, &c.

Vast forests were found of the *Coniferæ*, the tree-like *Lycopodiaceæ*, seventy to seventy-five feet in height, and two or three feet in diameter, the curiously formed *Sigillariæ*, and the *Calamites*, or gigantic *Equisetaceæ*, under whose shades numberless ferns, often too arborescent, sprang up, and the singular plant *Stigmaria ficoides* unfolded itself, with its dome-shaped trunk, expanding in forked branches often thirty feet long, and

furnished with thorny leaves projecting at right angles, well adapted to appropriate to itself, or to cover up, other vegetables.

This insular flora covered with its luxuriant growth, here the high arid plateaus, there recesses in the hills; in other places the basins and the valleys, among the still loftier ancient mountains. When this rich vegetation decayed, it was immediately followed by a new growth, as now happens in the tropics. In moist localities, also, peat-like beds were formed; and thus in the valleys and on the plains, at the feet and on the summits of the mountains, on the plateaus and in the hollows, immense masses of vegetable matter, the material of future coal-beds, more or less speedily accumulated, according as the soil, the situation, and the nature of the different plants favoured a more or less luxuriant growth.

This collected vegetation was buried in the strata which form the great coal formation, having been overwhelmed in the floods produced by the changes in level resulting from elevations and depressions. Where pebbles and detritus were wanting, the plants were converted into continuous seams of coal; but when mixed with sand or clay, they were inclosed and preserved in the gradually consolidating shales and sandstones. The coal itself contains similar plants to those found in the shales and sandstone above and below. The plants entombed in sandstone and shale could not form coal, because of the too great prevalence of earthy matter.

These inundations spared no part of the vegetation, but generally uprooted and overturned all the trees. A few only retained their natural upright position. In consequence of the high temperature of the climate at that period, which we may estimate at 77° to 88° (Fahrenheit), on the average, these plants soon fell into a kind of decomposition, which continued sufficiently long to destroy entirely the cells and the vessels in the interior, but in many places did not extend to the bark, but was checked in its progress by the withdrawal of the influence of the atmosphere. At this stage the *Coniferæ* and *Araucariæ*, formed of remarkably dense wood, though buried at the same time, had not proceeded

so far towards decomposition as the other plants, and therefore could not combine with them in a uniform mass. Hence we can account for much of what has perplexed us as to some of the fossils of the coal strata.

All the conditions, as the unvarying persistence of the beds over spaces of many fathoms, or even miles in extent; of the continuance for many fathoms, in the coal itself, of very thin layers, frequently not more than one or two lines thick; the regular inster-stratification (often over wide spaces) of the so-called fibrous coal—all these things speak decisively for the gradual deposition of the plants collected in one bed of coal.

Calculations prove indisputably, that the plants which can grow on an equal surface are insufficient to produce a bed of coal so thick as frequently occurs. To reconcile this fact with the peaceful deposition above assumed, we are compelled to conclude that many coal-seams (certainly not all) are to be regarded as the *turf-beds* of the ancient world. The peat mosses were formed during long periods of vegetable life, or in the same manner as the peat mosses of the present time, which often, as in Ireland, attain to a thickness of forty or fifty feet.

In the unaltered vegetable fibre, the proportion of oxygen and hydrogen greatly preponderates over the carbon; in brown and common coal the proportion is reversed. In the decaying vegetable fibre, the carbon continually increases, whilst the hydrogen and oxygen, united in compounds with carbonic acid and carburetted hydrogen, escape when the air has access. By inferences from these facts, we conclude that the separation of elements, which gradually converted the vegetable mass into coal, took place with the co-operation of moisture, or in the *humid way*.

The condition of the coal strata, broken twice by eruptive rocks, exhibits the effects of the action of heat—the *dry way*—in a decisive manner.

The influence of *Pressure* completed the processes above illustrated. The beds of coal, already in course of formation, were buried below the fragments of ancient mountains, broken up during the eruption of ancient massive rocks, or by volcanic showers, and violent spring-tides, with their detrital deposits.

Streams of mud poured out from volcanoes during these convulsions, or river sand and lacustrine deposits, which also enveloped the similar vegetation that from time to time appeared in particular localities, and is now met with in the slate-clays and sandstones. At the time of these deposits, the coal had already acquired a considerable degree of compactness.

Although no one seems to maintain, that this deposition of coal took place every where with equal tranquillity, yet observations in many localities, on the distribution of fossil plants, their division into groups, or the social and isolated occurrence of certain species, the absence of one kind and its replacement by another species of the same genus on the roof of one and the same bed of coal; and, above all, the wonderful preservation of fossil plants, which sometimes (in Silesia) appear like newly-dried, slightly-browned leaves, prove undeniably that they have been buried in the beds of clay-sand, either in their original place of growth, or not far from it.

I may here add to the above conclusion, drawn from Professor Göppert's essay, that the minute study of the structures and organic contents of the strata of different ages, has made us of late years more and more familiar with the hypothesis of a slow sinking of the ancient floor of the ocean, concurrently with the reception of repeated accessions of sediment. By the results of various observations, we learn many facts confirmatory of this theory. In Wales, and in the contiguous parts of England, a maximum thickness of 32,000 feet (more than six miles) of carboniferous, Devonian, and Silurian beds, has been measured; the whole of which were formed whilst the bed of the sea was continually and tranquilly subsiding.

In illustration of a movement of the same kind, we notice the coal-measures of South Wales, with their numerous under-clays, each containing *Stigmariæ*. All these *Stigmariæ*, which are found in the floor of every coal seam, are the roots *in situ* of fossil trees, chiefly of the genus *Sigillaria*, and they are occasionally attached to the stems or trunks—a conclusion fully confirmed by observations in the coal-fields of Nova Scotia.

In the old red sandstones of the Forest of Dean there are strata about 7000 feet thick, which bear evidences of having been formed in a sea of moderate depth. Fossil corals and shells, imbedded as they grew, or ripple-marked sandstones, and sandy or gravelly strata, with subordinate layers diagonally disposed, confirm these views. Such movements took place contemporaneously with the growth of organic matter, just as subsidence, on a grand scale, is now going on over vast areas in the Pacific and the Indian oceans.

I would strongly recommend to the reader a short study of the remains of the fossil-plants found in the coal formations. Works exist in fair abundance which will aid the study, from the great work of Lindley and Hutton, in several volumes, to the notices in numerous geological manuals. But a visit to the first, or highest, Geological Room of the British Museum, would afford most ready information, as in the side cases of that room numerous fine specimens are exhibited in due arrangement. Lesser collections are in the Geological Society's Museum, and the Jermyn Street Museum, St. James's. Provincial museums, public and private, possess fine series of coal-plants. I will only specify the Bristol Museum, in the Park Street Institution, the York Museum, and those at Newcastle, Manchester, Leeds, Scarborough, and Dudley. The Coal Exchange in London is adorned with good figures of the fossil-plants restored, and is well worth a visit. The common ferns are plentifully found, in impression, in most coal districts; and a few inquiries would soon bring some to light. By the by, the author's Museum is deficient in several of the less common coal-plants. That museum is supported by voluntary contributions, which will be thankfully received and acknowledged by the author himself. If any good mining friends wish to possess his autograph, let them send some good specimens of fossils to his museum, or to his publishers, Messrs. Longman and Co., who will forward them—if *carriage paid.* I do *not* ask for bread, but I do ask for stones. Remember this, all ye managers of mines, if you derive any instruction or amusement from my labours!

IMAGINED VEGETATION FROM WHICH COAL WAS FORMED.

The imagined vegetation from which coal was formed, has been thus restored in a graphic description by Hugh Miller.* We have brought before us "a low shore, thickly covered with vegetation. Huge trees of wonderful form stand out far into the water. There seems no intervening beach. A thick hedge of reeds, tall as the masts of pinnaces, runs along the deeper bays, like water-flags at the edge of a lake. A river of vast volume comes rolling from the interior, darkening the water for leagues with its slime and mud, and bearing with it to the open sea, reeds, and fern, and cones of the pine, and immense floats of leaves, and now and then some bulky tree, undermined and uprooted by the current. We near the coast, and now enter the opening of the stream. A scarce penetrable phalanx of reeds, that attain to the height and wellnigh the bulk of forest-trees, is ranged on either hand. The bright and glossy stems seem rodded like Gothic columns; the pointed leaves stand out green at every joint, tier above tier, each tier resembling a coronal wreath or an ancient crown, with the rays turned outwards, and we see atop what may be either large spikes or catkins.

"What strange forms of vegetable life appear in the forest behind! Can that be a club-moss that raises its slender height for more than fifty feet from the soil? Or can these tall, palm-like trees be actually ferns, and these spreading branches mere fronds? And then these gigantic reeds! are they not mere varieties of the common horsetail of our bogs and morasses, magnified some sixty or a hundred times? Have we arrived at some such country as the continent visited by Gulliver, in which he found thickets of weeds and grass tall as woods of twenty years' growth, and lost himself amid a forest of corn fifty feet in height? The lesser vegetation of our own country, its reeds, mosses, and ferns, seem here as if viewed through a microscope: the dwarfs have sprung up into giants, and yet there appears to be no proportional increase in size among what are unequivocally

* "The Old Red Sandstone." Edinburgh, 1841, p. 270.

its trees. Yonder is a group of what seem to be pines—tall and bulky, 'tis true, but neither taller nor bulkier than the pines of Norway and America; and the club-moss behind shoots up its green hairy arms, loaded with what seem catkins above their topmost cones.

"But what monster of the vegetable world comes floating down the stream, now circling round in the eddies, now dancing on the ripple, now shooting down the rapid? It resembles a gigantic star-fish, or an immense coach-wheel, divested of the rim.* There is a green dome-like mass in the centre, that corresponds to the nave of the wheel or the body of the star-fish; and the boughs shoot out horizontally on every side, like spokes from the nave, or rays from the central body. The diameter considerably exceeds forty feet; the branches, originally of a deep green, are assuming the golden tinge of decay; the cylindrical and hollow leaves stand out thick on every side, like prickles of the wild-rose on the red, fleshy, lance-like shoots of a years' growth, that will be covered two seasons hence with flowers and fruit. That strangely formed organism presents no existing type among all the numerous families of the vegetable kingdom.

"There is an amazing luxuriance of growth all around us. Scarce can the current make way through the thickets of aquatic plants that rise thick from the muddy bottom; and though the sunshine falls bright on the upper boughs of the tangled forest beyond, not a ray penetrates the more than twilight gloom that broods over the marshy platform below. The rank steam of decaying vegetation forms a thick blue haze, that partially obscures the underwood. Deadly lakes of carbonic acid gas have accumulated in the hollows; there is a silence all around, uninterrupted save by the sudden splash of some reptile-fish that has risen to the surface in pursuit of its prey, or when a sudden breeze stirs the hot air, and shakes the fronds of the giant ferns, or the catkins of the reeds. The wide continent before us is a continent

* The central portion of a *Stigmaria ficoides*, from the shale of Jarrow Colliery. It is figured in Lindley and Hutton's work, p. 31; and in Buckland's *Bridgewater Treatise*, p. 56, fig. 8. Some figures of coal-plants may be found in Richardson's *Geology*, p. 329, &c., and in the *Penny Cyclopædia*, "Coal Plants."

devoid of animal life, save that its pools and rivers abound in fish and mollusca, and that millions and tens of millions of the infusory tribes swarm in the bogs and marshes. Here and there, too, an insect of strange form flutters among the leaves. It is more than probable that no creature furnished with lungs of the more perfect construction could have breathed the atmosphere of this early period and have lived."

It is, indeed, a curious reflection, that the present commercial greatness of Britain should be intimately connected with the towering and thickly spread forests of arboraceous ferns and gigantic reeds, vegetables of strange forms and of uncouth names —which flourished and decayed on the surface of the earth, age after age, during the vastly-extended term of the carboniferous period—ere the mountains, in many masses, were yet upheaved, and while as yet there was no man to till the ground! Yet such truths geology teaches us, and of such curious facts the very coals at our sides, and in our parlour grates, remind us.

It is only of late years that we have arrived at any accurate knowledge of the ancient component vegetation of the coal-measures. It is not much more than twenty-five years ago since it was held that no exogenous* plant existed during the carboniferous period. The frequent occurrence of *Coniferæ* in the secondary deposits, had been conclusively determined from numerous specimens; but, by inference from what seemed a large amount of negative evidence, it was concluded that, previous to the age of the lias formations, nature had failed to achieve a tree, and that the rich vegetation of the coal-measures had been exclusively composed of magnificent immaturities of the vegetable kingdom, such as the gigantic ferns and club-mosses, that attained to the size, though not to the nature of forest-trees; and thickets of the swamp-loving horsetail family of plants, that wellnigh rivalled in height those forests of masts, which seem to grow like natural products on the rivers of our great commercial cities. This was the view taken by a once great authority in this branch of geological inquiry, viz. M. Adolphe Brongniart, and not with-

* *Exogenous*, literally, 'growing outside—that is, like the oak or beech, by the addition of rings of new wood to the rings of old wood inside.

out apparently sufficient negative evidence. It is quite certain that the inferior orders of plants were developed, in those periods of time, in a measure and magnitude which their present state of degradation can never exemplify. "There were giants in those days," and these were of them. Speaking of mere magnitude, these vegetable forms then took their place among the tallest and goodliest productions of the earth. Now, the same species are amongst the pigmies of the ground. A recent fern, or club-moss, or horsetail plant, is, when compared with one of the same kind in the carboniferous period of growth, as Tom Thumb to Daniel Lambert—the same in kind, but how different in size!

Although, however, these were the gigantic vegetable forms of the coal-forming period, they were *not* the highest in the scale of organization, as was formerly supposed; for the exogenous trees appear to have existed in great numbers, and also of vast size. Thus we find that the most abundant fossils of the coal-system are its true woods, in various localities in England and Scotland, such as Felling, Gateshead, and Wideopen collieries, near Newcastle-on-Tyne, and in quarries to the west of the city of Durham, and at Lennel Braes and Allan Bank, in Berwickshire. In the quarry of Craigleith, near Edinburgh, three huge trunks have been laid open during the last twenty years within the space of about 150 yards; and two equally massy trunks of trees have been laid open within half that space in the neighbouring quarry of Granton; and these localities are geologically low in the coal-measures. These trees lie diagonally across the strata, at an angle of about thirty, and with the nether and weightier portions of their trunks below, like those singular trunks, which are called *snags*, in the Mississippi. From the general direction of these fossil trees, we may infer that the stream in which they reclined must have flowed from nearly north-east to south-west. Probably this current was that of a noble river, which may have reflected on its broad bosom the shadow of many a stately tree. The river has flowed away—the current is dried up; the tree has remained behind, a stony monument of vast antique vegetation. How singular that its apparently accidental position indicates to us the probable course of a current, every drop of

whose waters were dried up centuries upon centuries before Eve shed her tear of penitence in sin-defiled Paradise!

With the exception of the Granton specimens, which still retain the strong-kneed roots, they are all mere portions of trees rounded at both ends, as if by attrition or decay; and yet one of these portions measures about six feet in diameter, by sixty-one feet in length; another four feet in diameter, by seventy feet in length. The others are of various thicknesses, but all are bulky enough to rival the masts of large vessels, and they range in length from thirty-six to forty-seven feet. The huge trees of Craigleith and Granton are of the Araucarian division of the coniferous family, and approach more nearly to the Norfolk Island pine (*Altingia excelsa*) than to any other living tree. This noble Araucarian rears its proud head to a height over the soil of from 160 to 200 feet; and exhibits a green and luxuriant breadth of foliage, rare among the *Coniferæ*. Specimens may be seen in the Kew Botanic Garden, and a young one in the Botanic Garden of Edinburgh.

Much light may be still thrown on the vegetation of coal. The fossil botanist, who should devote himself to the study of microscopic structures, would have to decide, I apprehend, from the facts of the case, not that trees were absent during the carboniferous period, but that, in consequence of their having been present in amazing numbers, their remains had entered more extensively and intimately into the composition of coal than have those of any other vegetable. Of some coals, a cubic inch contains thousands of vegetable cells.

CALCULATION OF AMOUNT OF VEGETATION IN COAL.

The following short calculation will give the results of all that can be conjectured on this inquiry.

"Wood affords in general about twenty per cent., and coal about eighty per cent., of charcoal.

"Neglecting the oxygen and hydrogen, therefore, it must have required four tons of wood to yield the charcoal which we find in one ton of coal. Let us then suppose a forest composed of

trees eighty feet high, that the trunk of each tree contains eighty cubic feet, and the branches forty, making 120; the weight of such a tree, at 700 specific gravity, will be two and a quarter tons; and allowing 130 trees to an acre, we have 300 tons on that space. Supposing the portion that falls annually, leaves and wood, to be equal to one thirtieth, we have ten tons of wood annually from an acre, which yields two tons of charcoal; and this charcoal, with the addition of bitumen, forms two and a half tons of coal. Now a cubic yard of coal weighs almost exactly one ton; and a bed of coal, one acre in extent and three feet thick, will contain 4840 tons.

"It follows, therefore, that one acre of coal is equal to the produce of 1940 acres (*i. e.*, 4840 divided by two and a half) of forest; or, if the wood all grew on the spot where its remains exist, the coal bed three feet thick, and one acre in extent, must be the growth of 1940 years! Even if we suppose the vegetation, like that of a tropical climate, to be twice as rapid as I have assumed, we shall still require about 1000 years to form a bed of coal one yard thick; and, as an example of a coal-field, for the thirty-six yards of coal in the Mid-Lothian coal-field, in Scotland, a period of 36,000 years!"*

DEPOSITION OF A COAL-FIELD.

"When geologists attempt to explain the formation of the coal strata, they are led to infer many changes of level in the land or water, and this branch of inquiry is attended with considerable difficulties. The sandstone, shale, and limestone, must all have been formed under water, and the coal on land, perhaps in a marsh. In the section of the Mid-Lothian coal-field, for instance, the coral limestone at the bottom must have been formed in the sea. We may then suppose the bottom to have been raised by the deposition of four fathoms of sandstone and shale, formed of *detritus* (waste) swept down from the neighbouring land, till the

* Maclaren's Geology of Fife and the Lothians; a valuable and laborious work, to which I am indebted for the above, and for the illustration of the Mid-Lothian coal-field. Several geological publications discuss this subject.

gulf or bay shoaled into a tract of marshy ground. Upon this forests grew for a thousand years; and the spoils of these accumulated where they fell, and formed a thick stratum of vegetable matter. The land must then have sunk suddenly or gradually under water to a great depth, and remained there perhaps for ten thousand years, till a fresh deposit of sandstone and shale, to the depth of 19½ fathoms took place, the pressure of which, aided by water, converted the stratum of wood into coal, No. 1. By this deposit the bottom was raised, the bay again converted into marsh or meadow, upon which vegetation again flourished for a thousand years, till the materials of a second bed of coal (No. 2.) three feet nine inches thick, were collected.

"A third submergence took place, nineteen fathoms of rocky strata were deposited, the water again shoaled into land capable of bearing plants; a third period of forests commenced, and continued till the mass of vegetable matter destined to form the bed of coal No. 3. six feet thick, was accumulated. This was followed by a fourth subsidence, during which six fathoms of strata were deposited. By this addition the land again rose above the water, was clothed with wood, and materials for a fourth bed of coal were then accumulated."

It is unnecessary to pursue the series of similar changes throughout the whole coal-field. Let it suffice to say, that "the land must have subsided more than thirty times, and descended through a space of 3000 feet, from the formation of the coral limestone to that of the uppermost beds of the group; and after these subsidences were completed, a series of counter movements, resulting partly from the agency of a peculiar igneous rock, called *trap*,* must have again elevated a great portion of the beds above water. Such numerous changes, when surveyed in the aggregate, and without reference to time, appear inconsistent with the usual stability of nature: but the inconsistency vanishes on a little reflection. The changes now produced by earthquakes, and the faults and fractures of the coal strata (of which we shall shortly

* Trap rock is found in masses and thin partitions bisecting other rocks, and in positions into which it has apparently been thrown in a molten form.—See what I say of *dykes* further on.

speak in detail), assure us beyond all doubt, that rocky masses have undergone movements both of subsidence and elevation. And as to their great number and apparent frequency in this instance, as I have supposed it, these would seem only proportional *when measured on the scale of geological time.* Only conceive them as being dispersed over a period of half a million, or one million of years, and the objection at once loses all its force."

THE "DRIFT THEORY" AND ITS DIFFICULTIES.

It may be proper to explain the *drift theory* in a succinct form. It is held by Mr. John Phillips, who thus explains its relations to the coal-fields of Yorkshire. The alternating beds he refers to alternating currrents, from different points of the compass, charged with different sediments, and passing into a great estuary or lake. He thinks that lime was transported by the marine currents from the south-east, because the limestone beds are thickest in that direction, and thin off towards the opposite point. Argillaceous (clayey) sediment was swept in by a river from the west, the shales being thickest in that direction. Sand and floating wood were drifted from the north, the beds of coal being thickest in that direction. This hypothesis, like the other, involves various, but perhaps greater, difficulties. I mention only a few of the principal ones.

Of the four currents bearing wood, sand, clay, and lime, how did it happen that three so generally suspended their action while the fourth was operating? Again, supposing the wood to be floated from the north, by a river which inundates its banks, like the Mississippi, it is plain that such a stream could carry off only a small part, probably not one-twentieth, of the spoils of the forest, annually deposited in its hydrographical basin. It follows, that to furnish materials for a bed of coal, extending over a given space, the river must have drawn its waters from an area thirty times as large as would be required if the wood were carbonized where it grew, or the period must have been thirty times as long. But looking to the extent (once much

greater than at present) of the coal formations in the north of England and Scotland, where is the continent to be found in which such a river could exist?

In fact, Mr. Phillips finds it necessary to admit, that the large tracts of land required to furnish the sediments of sand and clay, and the masses of vegetable matter, have disappeared in the northern and western oceans.

I think I can, in brief, comprise the principal remaining objections to the drift theory under six heads, and the reader will judge whether these objections are not formidable enough.

1. The first objection is—The purity of coal, and its freedom from extraneous substances. Had the material of the coal been drifted, it must assuredly have acquired some portion of foreign substances in its transit, such as pebbles and gravel; but we find many most extensive seams of coal entirely free from such admixtures.

2. The generally uniform thickness of each coal-seam almost precludes the supposition of drift. The thick Low Main seam of the great northern coal-fields, extends over a space of at least 200 square miles. One thin seam extends in a straight line from Whaley Bridge to Blackburn, a distance of thirty-five miles. Many seams of much minuteness, thinning out into mere filaments, lengthen out themselves over extensive areas of solid rock. The different specific gravities of various portions of the floating mass, in drifting floods, would have caused a different result.

3. Consider the size of the seams of coal in relation to the immense compression they have experienced. This is well illustrated by the visible effect of Bramah's hydrostatic press. Water would not transport such enormous accumulations of matter as those in which the coal-beds originated. Take the thirty-feet seam in Staffordshire, would water transport its materials in drift?

4. The preservation of many parts of the original vegetation, the perfect condition of leaves, the sharp angles of numerous stems of plants of a soft and succulent nature, the delicate streaks and flutings of some species—all destructible by drift.

5. The discovery of large portions of stems of trees, erect, and evidently as they originally grew. Six stems, with roots, five nearly in a line, were found near Manchester. No less than forty fossil trees, three or four feet apart, were discovered near Claycross tunnel. Near Lyons, a whole bed of fossil trees appears in a horizontal position.

6. Chemical objections are raised against the drift theory. Had such immense masses of vegetable matter been swept down by floods, the gaseous particles must have escaped, and coal could scarcely have been formed.

WHY COAL IS CONFINED TO CERTAIN LOCALITIES.

Many, if not most persons, think that coal may be found almost promiscuously in different parts of England. It was a common opinion years ago, that coal existed under Blackheath, near Greenwich; and it was said that it would be obtained, were not government afraid to injure that nursery of seamen, the sea-coal traders from Newcastle! But, in truth, no coal exists at Blackheath within a man's reach. If the reader will glance at any geological map of England, he will see the several English coal-fields marked out, and generally coloured in black or dark colours. In the map of Great Britain there would be four principal dark-coloured patches: one in Scotland, lying between Fife and Ayr, and Edinburgh and Stirling,* another in England, lying (we speak loosely) between Berwick and Durham, and in its width extending from the sea-coast far inland, into Northumberland. The third great patch would include many smaller patches, all lying towards the centre of England, and comprising the Lancashire, Leicestershire, and Staffordshire coal-fields, &c. The fourth great patch is seen in South Wales, extending from Monmouth towards Pembroke to St. David's. There are smaller patches lying around these larger ones, and forming coal-fields of small extent, and chiefly for local supply.

* These boundaries are very loosely given, and merely as they would appear on a small map. Accurate boundaries would require too much space for this brief notice.

Why should coal only be found in these localities? Because it has a precise and regular position in the series of British strata, and is never found in any very great or available quantity out of that position. Coal, as to its geological position, is known with as much certainty as the position of a floor in a house, or a volume in a series of books. Suppose all the British strata to be represented by volumes, say the volumes of an Encyclopædia, and that coal should be represented by volume 19; then you might as well expect to find volume 19 in the books, in the place of volume 1 or 2, as coal at Blackheath. A mere *modicum* of geology suffices to fix the true position of true coal.

Let me try to make this very plain and intelligible. For purposes of comparison, let us assume the whole series of English stratified rocks, from highest to lowest, to be about five miles thick; then the coal and the limestone rocks of the coal-bearing (carboniferous) strata will be represented by a certain portion of that series, occurring in a certain relative position to the other portions of the series. Their position, as to descending *order* of the coal-bearing strata, is invariable. Out of association with their relative strata they are never found,* even though these whole beds, that are connected with the coal, are often broken up and dislocated. The whole beds connected with the coal are termed *coal-measures*, and we may suppose them to be situated in the second mile downward. As to their relative thickness, we may fairly suppose them to be represented by something like one-seventh of the whole; thus leaving four-sevenths for the thickness of the strata below, and two-sevenths for the thickness of the strata above. Therefore, if a height of seven feet be marked on the wall of a room as representing the whole thickness of the English strata, then a horizontal line drawn four feet from the floor will represent the bottom of the "mountain limestone,"

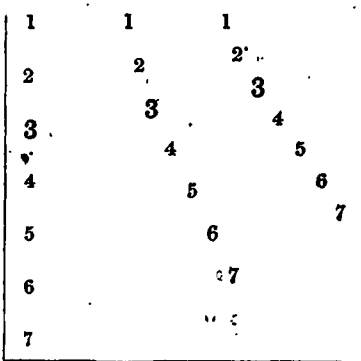
* We might say this law extends over Europe, as far as regards bitumenized vegetable matter, developed to any extent, and capable of being largely used for economical purposes as fuel. The lignites and imperfect coal of the oolites, and the brown coal of Germany and Switzerland, are capable of ignition, but yet do not form true coal. Geologists assume this as a fair, although it only partakes of the indeterminate nature of all negative propositions.

which is at the base of the coal-measures; and a line drawn six inches higher up the wall will give, between the two lines, the thickness of the mountain limestone; while another line, drawn five or six inches higher than the last, will, between the last and itself, exhibit the thickness of the coal-measures. By this means the eye will be enabled to appreciate the relative position and extent of the coal formation, and the mountain limestone which underlies it, and which, because of this propinquity, geologists call the "carboniferous limestone" or coal-bearing limestone. When you stand on St. Vincent's Rock at Clifton, near the observatory, you stand just where the coal should stand, and we may suppose has stood, until washed away by some tremendous deluge. And if you look around you from that most commanding eminence, you will see, especially towards Bath, a country that doubtless has much coal under the surface.

HOW COAL LIES IN THE EARTH: COAL FIELDS, OR BASINS.

But if coal naturally, or rather geologically, lies so low down in the lines of strata, how is it that it is sometimes found near (comparatively) to the surface of the earth, and again at other times very deep down?—Because, although all stratified rocks bear ample evidence of having been deposited horizontally, or nearly so, they show equally ample evidence of having been subsequently raised or depressed by various causes, some extending over large portions of the globe, while others are comparatively local. Now, you will here perceive a remarkable proof of benevolent design on the part of the Almighty Creator. Had he given us abundant coal, and yet permitted it to remain in its original *geological* position, it is probable that man would never have enjoyed the benefit of the coal; because it would have been too deep for his reach. He might have known it to be there, but it would have been beyond his power to pierce a mile or two into the earth. But by a wonderful and merciful providence, through the great catastrophes which this globe has evidently undergone in long bygone years, the strata have been most extensively dislocated; they have been upheaved, and in some cases elevated,

enormously out of their original positions, while in other cases they have been thrown down. This occurring on a large scale, and the elevated portions having often been denuded by water, you can easily conceive how large patches of coal will be brought within man's reach. If you take figures as representing the strata, then write down 1 2 3 4 5 6 7, each figure under the other, as in a sum at school. When thus placed exactly under each other, imagine a force from beneath to press them upwards from 7; then you would have the figures inclined and slanting, and if figure 3 should represent the coal measures, they would be nearer to the surface, thus :—

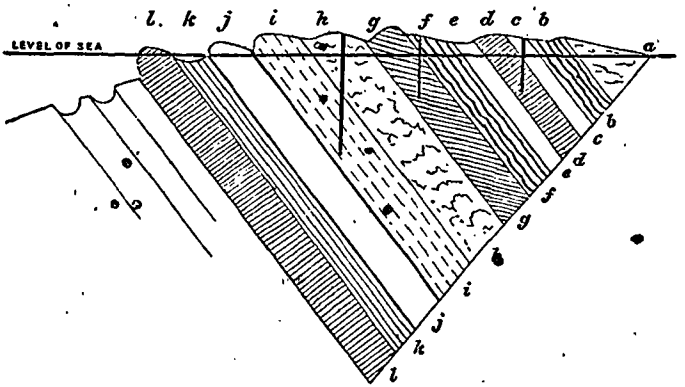


In this way you get at 3 more readily the more it has been upheaved, or the more the strata above it have been denuded. Refer again to your library. Place the 24 volumes of your Cyclopædia, one on the other, horizontally on the table; this would be the original position of coal. Next lift up the whole volumes; make them to incline a little, and you have nearly the actual position of coal. Make them to incline very much, and you may have vol. 19 at one edge, very near the highest position; and thus coal very frequently lies; and sometimes, though rarely, it lies in "edge seams;" that is, as vol. 19 stands upon the shelf when in library order, with the tops of the pages uppermost.

One other illustration may be taken from the tea-table. Your toast, when buttered and cut up, lies temptingly horizontal on its plate; *that* is the original position of the strata;—your bread and butter, however, lies inclined and edgeways on its plate; *that* is the actual position of the strata. Imagine the crust of the pieces of bread and butter to be the crust of the earth, and you have the stratification pretty accurately. You can get at any piece of bread and butter you like by taking hold of its own

crust, without disturbing the other pieces. Not so with the toast which lies flat. You must remove each piece of toast successively, to reach the middle or lowest piece. That is what we should have been compelled to do for coal (or rather could not have done), if Providence had not mercifully broken it up into patches or basins for our acquisition after due labour. I take this most familiar illustration, that the young reader may learn a lesson of science even at the breakfast-table.

Lest this very important point should be misunderstood, I adjoin a slight sketch (Fig. 1,) which may impress the fact upon the memory. If the strata represented by the letters *a b c d e f g h i j k l*, had been horizontal now as they were at their first deposition, then we could never have reached the beds of *d g i;* for the deepest mines in the world penetrate little more than



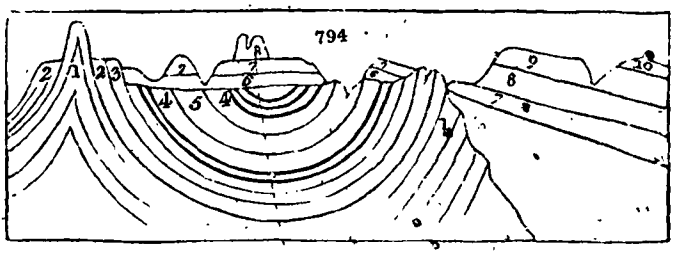
half *a* mile below the surface, and this might be conjectured to be equal only to about the eight-thousandth part of the distance from the surface to the centre of the globe; so that practically we should have only the alluvial or tertiary and most recent strata. But by the upheaving forces which have, in ages long preceding man's appearance on the earth, elevated large masses of the strata, the lower beds of the strata of the earth have been often brought to the surface in certain portions and positions. And thus we meet with the beds *d g i* dropping out in hills and

valleys under our very feet, and can sink pits into them as we think best. Observe that every one of the beds from *a* to *l* comes within observation and reach by this benevolent arrangement of Providence; and those of *d g i* represent coal-beds; thus we can sink through them (as indicated by the thick black vertical lines), and bring their products to the surface. Thus, too, we can make use of the contents of each bed successively, by merely continuing the same shaft. Limestone, coal, and ironstone, are frequently associated in successive and neighbouring beds. In sinking for one, you often pass through or near the other. If *c* be ironstone, and *e* limestone, one and the same shaft would pierce through all. In Staffordshire you may find capital ironstone for the great iron works,* and near to it suitable coal for the furnaces that smelt the ironstone. But limestone is necessary as a flux to separate the metal from the ore: how remarkable that this third and last requisite should commonly abound in the lower beds, under the coal-measures!

The most characteristic type that exists in this country of the general condition and circumstances of the strata comprising the great carboniferous order (*i. e.*, the coal-containing order), is found in the north of England. It appears from a section of the strata from Newcastle-upon-Tyne to Crossfell in Cumberland, that their united thickness along this line exceeds 4000 feet. This enormous mass is composed of alternating beds of shale or indurated clay, sandstone, limestone, and coal. The coal is most abundant in the upper part of the series, near Newcastle and Durham; and the limestone predominates towards the lower part. The individual strata are thirty-two beds of coal, sixty-two of sandstone, seventeen of limestone, one intruding bed of a peculiar rock termed *trap*, and one hundred and twenty-eight beds of shale and clay. As the animal remains hitherto noticed in the limestone beds are almost exclusively marine, we infer that these strata were deposited at the bottom of the sea.

* The strata below the thick coal of Staffordshire, Worcestershire, and Shropshire, contain several seams of valuable ironstone, weighing from four to six cwt. per square yard, and yielding from forty to sixty per cent. of iron. The celebrated *blackband* ironstone of Scotland is contiguous to the coal.

We have thus far spoken of the upheaving of large masses of coal-bearing or carboniferous strata; and we may add the singular fact, that many of these separate masses seem to have a tendency to shape themselves collectively into a boat or basin form; hence they are often called coal-*basins*, as well as at other times coal-fields. The South Welsh coal-*basin* is specially entitled to this name; for you may trace out a very near approach to the basin or boat, which is rather elongated and narrowed towards St. Bride's Bay. In the great northern coal-field of Newcastle, the strata appear to dip from the surface and rise again to it after attaining a certain depth, so that a section of them suggests the idea of a boat or basin; and a place called Jarrow, about five miles from the mouth of the Tyne, and on its southern bank, is the spot beneath which the beds of coal in the *coal-measures* are found at their greatest depth. Several important advantages arise from this disposition of the coal-measures. The coal is attainable at unequal depths, and occasionally near to the surface. Therefore its attainment claims continued industry and fruitful invention. It cannot be all exhausted in a short time; and several mining and economical purposes are answered by this arrangement. We shall now be ready to understand, that the great coal series consists of a regular alternation of mineral strata deposited in a great concavity or basin, the sides and bottom of which are composed of what geologists term *transition rocks*. The arrangement will be conceived by an inspection of the adjoining diagram, which represents a section of the coal fields



south of Malmesbury. The figures stand as follows:—1, represents the old red sandstone; 2, mountain limestone; 3, millstone

grit; 4, 4, coal seams; 5, Pennant, or coarse sandstone; 6, new red sandstone, or red marl; 7, 7, lias; 8, 8, inferior oolite; 9, great oolite; 10, cornbrash and forest marble. All these terms are the geological designations of the British strata, which I will not more particularly describe, as they belong to geology proper, and may be found explained in any manual of geology.

But I may say a little on the coal measures in this diagram. Their aggregate thickness in this locality or basin, amounts to about 500 fathoms. 1. The lowest beds, which reflex on the mountain limestone, are about 40 fathoms thick, and consist here, as in the Bristol coal-basin, of a red siliceous grit, alternating with conglomerates used for millstones, and with clay. 2. These beds are succeeded by a vein about 120 fathoms thick, in which a grey gritstone predominates, alternating in the lower part with shale, and containing six seams of coal. 3. A bed of grit, 25 fathoms thick. 4. Beds of from twelve to fourteen seams of coals, alternating with shale, and about 115 fathoms thick. 5. A straw-coloured sandstone, of about 100 fathoms thickness, forming a high ridge in the interior of the basin, and containing several thin seams of coal. 6. Twelve fathoms of coal seams and alternating shales. 7. Alternate beds of grit and shale, whose aggregate thickness is about 100 fathoms, and which occupy a tract in the centre of the basin, about four miles long and two miles broad.

DISLOCATION IN COAL FIELDS; FAULTS, DYKES, SLIPS, &c.

I have thus far spoken of coal-fields, or coal-basins, in the whole; and I have shown how they are deposited, and assume a boat or basin like form.

But I am now about to explain the character of the dislocations so common in coal-fields, by which they are in effect broken up into smaller fields, or accessible portions. A study of the illustrations below, will afford some idea of the manner in which the coal basins are broken up by what are geologically and locally termed dykes, faults, troubles, slips, and hitches. By means of

these expressively named phenomena, one portion of a continuous stratum, or series of strata, has been broken away from the rest, and has been displaced either by elevation or depression, or shifting on one side for various distances. The amount of displacement is sometimes only a few inches, and at other times several hundred fathoms, and the extent may be twenty yards or twenty miles. In small faults, the space between the fractured edges of the beds is almost imperceptible, while it is occasionally filled up by thick walls of igneous rock (of a very different geological age), apparently poured into the open fissure in a melted state. In this latter case the fissure with its contents is called a "dyke," as a "trap-dyke," or a "whin-dyke," according to the contents of the fissure. Such dislocations characterize almost every coal-field. They are neither uniformly advantageous, nor always disadvantageous, to the immediate interests of the miner; but there cannot be the slightest doubt, that to such disturbances we are indebted for frequent repetitions of the same bed of coals at the surface, when without them it would be so covered up by more recent deposits as to be utterly unattainable. If, in prosecuting his labours, the miner is occasionally stopped by a fault in following what he considers to be a valuable seam of coal, and finds the coal shifted several yards above or below, he must not forget that it is perhaps owing to these very shifts that the outcrop of the coal has occurred at all in his vicinity, and that the coal is workable throughout a very large portion of the district in which he is interested.

There is, too, one most important advantage derived from the existence of these numerous faults in coal strata; namely, that they intersect a large field of coal in all directions, and by the clayey contents which fill up the cracks accompanying minor faults, they become natural coffer-dams, which prevent the body of water accumulated in one part of the field, from flowing into any opening which might be made in it in another part. An instance of the advantage arising from the presence of a great line of fault occurred in the year 1825, at Gosforth, near Newcastle, where a shaft was dug on the wet side of what is locally

termed the great Ninety Fathom Dyke, which there intersects the coal-field. The workings were immediately inundated with water, and it was found necessary to abandon them. Another shaft, however, was sunk on the other side of the dyke, only a few yards from the former, and in this they descended nearly 200 fathoms, or 1200 feet, without any impediment from the water. Thus you see, by the natural interposition of the great dyke, an enormous wall was built up through the strata, and while in the absence of this wall they must have abandoned all thoughts of coal, they got over the wall, and thereby got over the difficulty. Water is one enemy of miners; but fire is another, and as great a one. Now, the dykes or faults are friends in need against both foes; for the separation of a coal-field into small areas by these friends is very beneficial in case of fire in a coal-pit, since in this arrangement the combustion is prevented from spreading widely, and destroying, as it otherwise would, the whole of the ignited seam of coal. Let it not be supposed that fire is a mere imaginary enemy in this form; for many instances are on record of such fires having occurred, sometimes spontaneously from the decomposition of iron pyrites in contact with moisture, sometimes from lightning, and sometimes wilfully, in consequence of quarrels between the workmen and the coal-owners. Such fires have been known to burn on slowly for many years; and within the last twenty years there has been more than one instance of extensive subterraneous fires, which have destroyed many acres of coal. In such a case, what would not the coal-owner give for a good dyke? It would be to him worth more than all the parish engines in England.

A dyke is called upcast or downcast, as it throws up the coal or depresses it. The well-known walls and seam, near Newcastle, which is known to crop out to the northward of that town, is, by the intervention of a downcast dyke, depressed at least 100 fathoms, and thus forms a new coal-field. In mining from the rise to the dip of the beds, the occurrence of an *upthrow* dyke is hailed as a great benefit. Thus, whether the dyke be upthrow or downcast, it makes the coal to be advantageously disposed.

Generally a whin-dyke, which consists of a mass of whin (or basalt) intersects the coal without elevating or depressing it. These dykes will intersect the coal districts in some cases for several miles, as does the Cockfield dyke in the county of Durham. Such dykes are found in solid basalt, ten to twenty yards in thickness, and, from the vertical direction of their sides, they leave no room to doubt that the coal strata had at one period been entirely severed, and the severance-space filled up with the basalt in the state of burning lava. As a curious proof of this, we find that the seams of coal through which these solid dykes pass, are cindered on each side still to a considerable distance.

The Cockfield dyke (filled with a kind of greenstone) is seventeen feet wide, and is traceable for a distance of seventy miles, running in a direction south-east. Within fifty yards of the dyke the coal begins to change; as it comes nearer it wears the appearance of half-burnt cinders; and on approaching still nearer the volcanic ruins of the dyke, it grows less and less in thickness, until it becomes only two and a half feet thick, and is like a pretty hard cinder—eight yards further it is converted into real cinder. And when the seam of coal is reduced to nine inches in depth, it becomes by degrees a black substance, called *swad*, resembling soot caked together.

In the immediate neighbourhood of Newcastle there is a very considerable basaltic dyke, which passes through Coley Hill, about four miles west of the town. A long range of quarries have here been opened upon it, in some places to the depth of fifty feet, and laying bare the entire width of the dyke, which is twenty-four feet. In this place it appears to be vertical. The upper seam of coal is here found at about thirty-five feet from the surface, and where in contact with the dyke, is completely charred, forming an ash-grey porous mass, which breaks into small columnar concretions, exactly resembling the coke obtained by baking coal in close iron cylinders in the process of distilling coal tar. The basalt itself, when broken, is of a greenish-black colour, and of a coarse-grained fracture. At Walbottle Dean, five and a half miles west of Newcastle, a double vein of basalt crosses the ravine in a diagonal direction, passing nearly due

east and west. It underlies at an angle of seventy-eight degrees, and cuts the coal strata without altering their dip. Another dyke is seen on the banks of the Tees, a little below Jarrow, which passes into the newer red sandstone, and, continuing its course in the same direction, is well known to traverse the north-eastern part of Yorkshire, near the still more recent formation of lias, and the sandstone of the inferior oolite, in the Eastern Moorlands, in its way to the German Ocean. This dyke is rendered highly interesting by its great length, and the proof it affords, by penetrating later rocks, that it must have owed its origin to causes in action at a period long subsequent to the formation of the coal. This proof yields a strong analogical presumption, that the other dykes of the coal-field are likewise subsequent to the coal, and not contemporaneous with it.

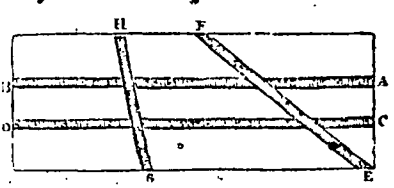
The whole of the Newcastle coal-field is full of dykes, faults, and slips, traversing the strata every where, and not preserving any uniformity of direction. Mr. Sopwith, a mining engineer, has constructed some admirable models of the effects of disturbances in this coal-field. They are twelve in number, and Model 5 particularly represents dislocations of the coal strata. The whole may be seen in the Economic Geology Museum, in Jermyn-street, London; and may be purchased in smaller sizes. Two sides of the Model 5 (which is a squarish piece of box-wood, consisting of inlaid pieces to show the strata), represent the horizontal deposition of the carboniferous rocks, undisturbed by lines of fault; the other two sides exhibit a series of dislocations, such as commonly occur in coal and mineral districts. It is impossible to give any fully intelligible description of the effects of dykes and faults without models, or several drawings. Considered on a large scale, it may be said that dykes have acted as fortifications to the coal. In some places, they are as walls to defend it; in others, as levers on a large scale to lift it up; in others, as partitions to divide it.

Few coal-fields are more shattered by dislocations and disturbing faults than that of Coalbrook Dale, in Shropshire. Deposits several thousand feet thick are shivered into fragments, and the broken remnants placed in most discordant portions, and at

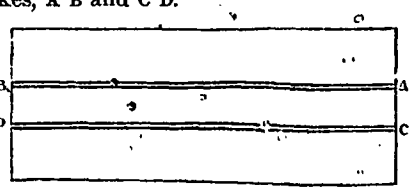
levels differing many hundred feet from each other. These disjointed beds of coal and ironstone are brought together. All the large and main faults vary greatly in the course of short distances. The Ketley fault at one place produces a change of level of 500 or 600 feet; and again, at two miles from this, a change only forty or fifty feet. The Lightmoor fault at one place produces a change of level of 300 feet; at another, of nearly 700 feet; at another, of 350 feet. Elsewhere we have variations of 400 or 450 feet; and again of 500 feet.

The edges of the disjointed strata are generally much bent—the bend being generally flanked by a series of small faults. This phenomena is termed by the colliers, "the splitting of a fault." In a table given by Mr. Prestwich of the faults in Coalbrook Dale, there is a column containing the supposed average amounts of disturbance. The highest amounts are the Wrekin (of Shropshire), 4000 feet; Lilleshall, 3000; Madely, 2000 feet (from 100 to 2000); and Swinney, from 100 to 2000 feet. Of course, these figures are assumed, but they show the possible extent of disturbance. We take no notice of the pitmen's very small disturbance, which they expressively call "hitches" or "troubles," or "nips" or "slips." Many curious facts have been observed with reference to the angles formed by faults with the adjacent beds, but we cannot deduce at present any law from these observations.

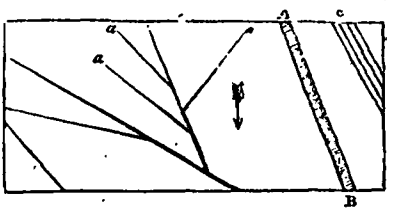
The figure here given represents a ground plan of a coal-field intersected with greenstone *dykes*. A B and C D, are two dykes standing parallel to each other; E F and G H, are cross or oblique dykes, which divide both the coal strata and the primary dykes, A B and C D.



In this figure is shown the ground plan of a coal-field with two *slips*, A B B and C D, in the line of bearing of the planes of the strata, which throw

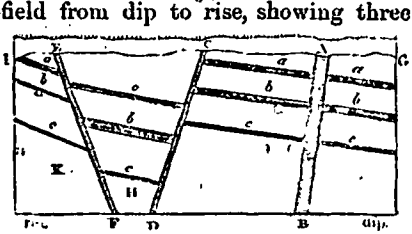


them down to the outcrop. This is the simplest form of a slip.

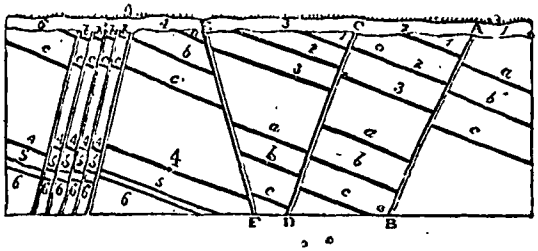


The next figure exhibits part of a coal-field intersected with slips, like a cracked sheet of ice. Here A B is a dyke, while the narrow lines show faults of every kind, producing dislocations varying in amount of slip from a few feet to very many fathoms. The faults at the points *a*, *a*, *a*, vanish, and the lines at C, denote four small partial slips, called *hitches*.

But the effects of slips and dykes in coal strata, appear more manifestly when viewed in a vertical section than in a ground plan, in which latter they appear merely as walls, veins, or lines of demarcation. I therefore illustrate, by another diagram, a vertical section of a coal-field from dip to rise, showing three strata of coal *a*, *b*, *c*. A B represents a dyke at right angles to the plane of the coal-beds. This rectangular wall merely separates the coal-measures, affecting their line of rise; but further to the rise, the oblique dyke C D interrupts the coals *a*, *b*, *c*, and not only disjoins them, but throws them and their concomitant strata greatly lower down; yet still, with this depression, the strata retain their parallelism and general slope. Near to the outcrop, another dyke, E F, interrupts the coals *a*, *b*, *c*, not merely breaking the continuity of the planes, but also throwing them moderately up, so as to produce a steeper inclination, as shown in the figure. It sometimes happens that the coals in the compartment H, between the dykes C D and E F, may lie nearly horizontal, and the effect of the dyke E F is then to throw out the coals altogether, leaving no vestige of them in the compartment K.



A still more complicated effect of slips on coal strata, may be displayed in another illustration.



This is a vertical section, in which *a*, *b*, *c*, are coal seams with their associated strata, and A B is an intersecting slip, which throws all the coals of the first compartment much lower, as is observable in the second compartment, No. 2. From the amount of the slip, it brings in other coal-seams, marked 1, 2, 3, which are not found in the compartment No. 1.

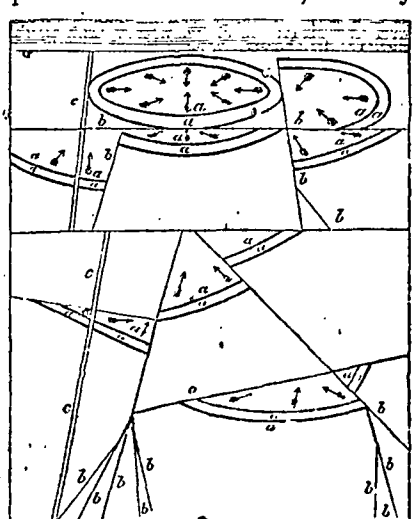
Again, C D is a slip producing a similar effect, but not of the same magnitude; while E F represents a slip across the strata, reverse in direction to the former: the effect of this latter is to throw up the coals, as shown in the area in 4. Such a slip occasionally brings into view other seams seated under those marked *a*, *b*, *c*, as shown at 4, 5, 6; and it may happen that the coal marked 4, lies in the prolongation of a well-known seam, as *c*, in the compartment No. 3, and then the case becomes puzzling to the miner. Besides these, a number of slips or hitches are often seen near one another, as in the next area or compartment to the left, No. 5, where the individual displacements are inconsiderable, but the aggregate dislocation may be great, in relation to the seam of the 6th and last compartment.

From this latter illustration especially, it will be seen that the study of the position of dislocated coal-seams is often very perplexing, and diagrams might be added which would show even still more complicated problems. Generally, in each district, there are local mining engineers, who have made the strata their particular study, though several of the coal-fields have only simple phenomena. In the north, at Newcastle and around it, are some able

viewers and mining engineers, whose knowledge is ample and accurate.

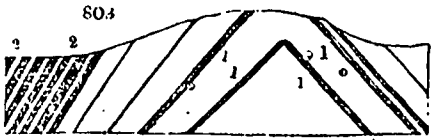
I have intimated that the most complete form of a coal-field, or what we consider to be its prevailing shape, is a basin, thence called a coal-basin. A beautiful example of this figure is found at Blairengone, in the county of Perth, in Scotland. By the aid of a diagram, I think I can make it manifest how this original form is commonly broken up by geological catastrophes, so that you could only recover the original shape by a very careful study of all the parts of a broken up coal-basin.

This diagram is designed, to explain an extensive district of country containing a great coal-basin, which is divided into numerous subordinate coal-fields by violent dislocations. The lines marked *b*, are slips or faults; the broad lines marked *c*, denote dykes; the former dislocating the strata and changing their level; the latter disjoining the strata by an intruded wall, but not commonly affecting their elevations. The two parallel lines marked *a*, represent two seams of coal, variously heaved up and down by the faults, while the dykes pass through the strata without heaving up and down materially. In such a manner the original elliptical coal-basin at the top of the diagram may be broken up and distributed in *partial* coal-fields, over a wide area of country, in almost every direction.



In one instance, as illustrated in the adjoining diagram, we have an *inverted* basin, or convex coal-basin. This is the Dudley coal-field, as found near the Castle Hill, Dudley, Worcestershire. Here 1, 1, are

limestone strata; 2, 2, are coal. Through this hill canals have been cut for working the immense beds of limestone. These occur in the lower series of the strata of the coal-field, and therefore at the distance of many miles from the Castle Hill, beyond the outcrop of all the workable coals in the proper basin-shaped part of the field; but by this apparently *inverted* basin-form, these limestone beds are elevated far above the level of the general surface of the country, and consequently above the level of all the coals.



In this Dudley coal-basin, the upper coal-bed has the remarkable thickness of *thirty feet*, which, for British coal, is astonishing, and this mass extends seven miles in length, and four in breadth. In this district coal-seams five or six feet thick are called *thin* seams; in Newcastle they would be called *thick* seams.

STARTING FOR THE NORTH; ITS SIGHTS AND SCENERY.

I have now said as much of the natural history of coal in general, of its deposition, and distribution, and dislocations, as I have space to say in this little work. I do not, however, think that any thing is wanting to a fair understanding of this part of my objects in writing this book. I do not know where the reader could obtain the same information in so few and plain pages. Thus much of the science of coal is essential before we can profit by travelling in any pit district; and much more ought to be known before visiting the Newcastle Collieries for any scientific purpose.

We may, I think, now start on our journey to the north, where I hope the reader will travel with me, at least, to the end of this book. I propose to make him acquainted with every thing connected with the great collieries. It is not only the pits themselves that claim attention. The towns and the rivers, the natural scenery, the approaches and the departures, the en-

tire commercial character of the vicinity, and the aspect of humanity itself, have all some kind of association with the coal-mines. From Durham Cathedral, haughty in its towering grandeur, and St. Nicholas' Church in Newcastle, celebrated for its arched spire, down to the humblest cottages in the pit villages, all have had some help from coal. From the Bishop of the diocese, and from the Coal Lords, and the Newcastle Quay Merchants, down to the errand-boy in their offices, and the stable-boy in the mansions, and the trapper-boy in the pits, all derive some of their prosperity, or their provender, from coal and its workings. Come then with me, reader, and see the wondrous produce, direct and indirect, from that black mineral. Gaze upon all kinds of buildings, on bridges, churches, rivers, cottages, engine-houses, chimneys, boilers, railways, coal-waggons, colliers, pits, shipping, and a hundred other things around this great coal country!

NEWCASTLE—THE METROPOLIS OF COAL—OLD AND NEW.

Newcastle is not built *upon* coal, but it may be said to be built *by* coal. Taking it all in all, few places in the empire possess more varied and greater claims to notice. Here the *Antiquary* may find much in his way, in old crooked lanes, queer antique houses, and numerous traditions. Its history presents a mine of subjects for interesting reflection. It stood in the breach, as it were, between England and Scotland, to say nothing of the various remoter contests of Romans, Britons, Danes, and Normans. Of course it is often mentioned in the histories of wars of Scotch against English, and English against Scotch, or against one another. Amongst these events, some of the most curious are those which occurred in the time of the Edwards.

The most conspicuous period, however, of Newcastle's old history, is that recorded in the wars of King Charles and the Parliament. It was beleaguered by the Scotch army under old Lesley, in 1642. Lesley, dividing his forces, assailed it on all sides with the utmost fury. The Marquis of Newcastle stoutly maintained it against him. On the 6th of May, 1646, the

unfortunate monarch having thrown himself under the protection of the Scotch army, was conducted to Newcastle, where, perceiving the treachery of his countrymen, he attempted to escape out of their hands. A ship was to have been in readiness to carry him abroad, but false friends were in the secret, and the plot was divulged. He was in disguise when taken. The greedy Scots, lest so rich a prize should escape out of their hands, sold him to the English for £200,000. Charles was handed over to commissioners appointed to receive him, and conducted from Newcastle to Holmby House, in Northamptonshire." In the succeeding struggles, Newcastle was garrisoned for the Parliament, and the names of Cromwell, Sir Arthur Hazlewood, Colonel Fenwick, and Lord Fairfax, are interwoven with the history of the town at that eventful period.

Its old walls; with the exception of a few sturdy fragments, and one or two solitary towers, are pulled down. From being a town of military importance, it has now become one of commercial character. And what has made it such but the greater development of the treasures of coal adjacent to it? The whole town and its vicinity should be viewed with this idea. A recent visiter to it has so well detailed it, and the first impressions of the colliery district, that I cannot do better than employ his words. Speaking of Newcastle, he observes:—"Wide over its hills stretch its dense buildings, and its tall chimneys vomiting volumes of blackest smoke. On its river lie masses of ships, and others with busy steamers are sailing up or down it. You feel at once that war has long had its day, and that a host of active beings are eagerly at work on the arts and acquisitions of peace. If you approach from Durham, Gateshead on one side, high and dense with houses, and swarming with population, and cloudy with the smoke and soot of many a manufactory, stands before you. On the other side (of the river Tyne), stands high Newcastle on *its* hills, and deep between them rolls the Tyne, with all its ships and coal-boats, and with its banks lined with coal deposits, and a hundred other black and wealthy erections. A bridge, bearing a ducky and somewhat melancholy resemblance to London bridge, and spanning a lesser Thames, links these two

populous towns into one; and right and left up the river, and down the river, on this side of the country and on that, the kindred objects of coal-mines, and railways, and steam-engines, and a hundred thousand grimy buildings and creatures, smokes, and fumes, noises and commotions, blend the two towns into one unique and indivisible existence." To the Author's view, however, the two towns thus blended together, did not seem so unique; for he likened Newcastle to the city of London, the Tyne to the Thames, and Gateshead to the Borough and Southwark, nor is the comparison inappropriate, the scale of the northern towns being very small. But let us proceed with our friend's description. The New High Level Bridge is added since this description.

"A strange mixture of ancient and modern objects strikes your eye in the more lofty and prominent features of Newcastle. There stands tall, and stalwart, and square, and black as ink, the old donjon-keep of Robert Curthose, the son of the Conqueror, from which the town derives the name of *New*-castle. To the left, still higher, towers over the town the fine steeple of St. Nicholas (of which you may see a poor rival from London bridge), and to the right the new and lofty column in honour of Earl Grey. Here, along the banks of the river, you see ranges, one above another, of dim and dirty buildings, which have stood for centuries amid the smoke of the great capital of coal—and there, on its bold eminence, a Grecian fabric, standing proudly aloft like the temple of Minerva in Athens. Beyond it again, you catch the tops of houses and ranges of streets, that indicate a degree of modern magnificence which at once astonishes you, and stimulates you to nearer inspection in the midst of so much that is different."

Newcastle has doubled its population within from thirty to forty years. It has been enriched almost entirely by the coal trade, which attracts vessels from all parts of the world to discharge their merchandise upon its quays. By the exchanges which follow these transactions, a multitude of trades are called into activity, which in their turn give employment and wealth to industrious thousands, who, spreading over the neighbourhood,

form new and flourishing communities. In this way North and South Shields, at the mouth of the Tyne, and many intermediate villages on its banks, have sprung up within the memory of persons now living. Of the coal annually consumed in London, one half may be said to be supplied at Newcastle.

There is, perhaps, no town in England whose present condition and aspect are more in contrast with its earlier appearance and character, than Newcastle-upon-Tyne. It owes its origin to war, its establishment to the spirit of religion, and its increase to the spirit of commerce. The great wall, which was built by the Romans nearly 1800 years ago across the narrowest part of England, ended near the hills on which Newcastle stands. The wall ran from the Solway Firth to a point on the banks of the Tyne, three miles east of Newcastle, and called to this day Wallsend. This is the origin of that world-renowned *Wallsend*, which is prefixed to all coal that people call the best. Certainly there seems to be no end of this Wallsend, though there has long been an end of the coal from the old pit so named.

A great number of religious establishments and monasteries seem to have been founded here in ancient times. The Augustine Friars' Monastery was perhaps the principal religious house of the place. Old historians say that the kings of Northumberland were buried in it, and that the kings of England made it their abode in journeying northward. The Town-hall or Guildhall is a very ancient building with a new face. Its old architect, Robert Trollope, lies buried in Gateshead churchyard under this epitaph :—

"Here lies Robert Trollope,
Who made yon stones roll up;
When death took his soul up,
His body fill'd this hole up."

RICHARD GRAINGER, HIS GENIUS AND CREATIONS.

It was in 1819 when the great benefactor of the town, Mr. Grainger the architect, saw the great capabilities of the locality, and began to form his scheme of improvement. Up to that time

the town was shabby, the streets were circuitous, and the population, consisting of 43,000, was too much crowded, especially in the lower parts of the town. His own rise, as well as that of his buildings, is greatly to the credit of Mr. Grainger. His father was a porter employed on the quay. At the time of the architect's birth, the family lived in two small rooms. Richard (the architect) had no other schooling than what he got at a parish charity-school. He is even now remembered by some old folk as a charity-boy, in a green badge-coat, with a round, ruddy, and smiling face, and a quiet manner. This appearance he in some manner now preserves. I very much enjoyed a brief conversation I had with him, respecting his architecture. He is, but scarcely seemed, a man of genius; so quiet, calm, and healthy did he look.

His history—the course and causes of his rise—his advance from one small undertaking to other and larger undertakings—are highly interesting; but we must dwell on the details. His first great enterprise was the erection of Eldon Square, composed of handsome stone houses of a solid, plain, and uniform style. He began this in 1826. He seems to have had an excellent and well-dowered wife, with a fortune of £5000, which was the foundation of his present large property. He next projected Leazes Terrace and Crescent, containing seventy first-class, and sixty second-class houses, with polished stone fronts, and highly ornamental. This enriched him. He then projected the Arcade, perhaps the least successful of his works. We wish he had devised some plan of keeping it quiet on a Sunday night, when it is filled with all the aspiring linendrapery and servanthood of Newcastle. There are the Post-office, and many other offices. Grainger has now enriched his native town with property of the value of nearly £200,000. This was before beginning his "New Town," and consisted of early erections, of Eldon Square, Leazes Terrace and neighbourhood, and the Royal Arcade.

At length Mr. Grainger purchased twelve acres in the middle of the town, a spot known as Anderson's Place, for the sum of £50,000—a bold stroke for an old charity-boy! Great was the public curiosity to know his object, but he kept it a profound secret

for some time. He matured his plans in his own office, and not a particular was known until his arrangements were completed. Without act of parliament he had bought other old property to the amount of £45,000, being enough to enable him to open communications between some of the busy parts of the town, distant from each other, and which before could only be reached by widely circuitous ways. He now formed a central street, and his plans being too large and bold for his powers, he associated with him the town-clerk, and submitted his designs and proposals to public inspection. The popular voice was so strong and loud in favour of their execution, that the town corporation gave up the old market, which stood in the way, and, taking £15,000 for the old, gave £36,000 for the new one, which was opened in 1835. The occasion was celebrated by a grand public dinner in the market, at which about 2000 citizens were present, besides 300 ladies. It was then declared that Mr. Grainger alone designed all the essential points in the erections for which he was responsible.

This market is the finest in the kingdom, exceeding even the Hungerford and Liverpool markets in size and convenience. The entire market covers a space of 336 feet by 247 feet. Its area is two acres. It has fourteen entrances from the street, and contains 243 shops to shut up and lock. The basin of each of the two fountains holds 3000 gallons.

A theatre stood in Grainger's way. In order to get rid of its injury to his plans, he generously gave the proprietors a new theatre for their old one, and the sum of £500 to boot—terms, I have confessed to Mr. Grainger, I should be willing to take for my museum. Some folk wanted to put a stop to his pulling down the old theatre, and intended to apply for a legal injunction; but within three hours from the sealing of the contract, the chimneys of the theatre were down, and, before any message could have reached London, the whole building had disappeared! He had in one place an obstinate house and householder to remove. Different owners made difficulties, for it had cellars belonging to other parties. The purchase was at last effected, and the same evening the inhabitants were removed to another house prepared

for them. In the morning the house had disappeared! Crowds came to see it, and found it not. The ground for the new town was now cleared, but great fatigue and anxieties were occasioned by difficult excavations and levels. The outlay of money and labour in preparing the ground alone was immense. Old property was to be purchased, hills had to be levelled, and valleys filled up, to unite new streets with old ones. After filling up the valleys from the levelling of the ridges, soil was carted away at 2*s.* per load, to the amount of £1040, which was paid to one individual; by others there were carted 250,000 loads, at 18 cubic feet per load, this amounted to four millions and a half of cubic feet, or enough to cover 103 acres of ground one foot thick. The raising and carting, exclusive of the cost of deposit, amounted to £21,500.

External difficulties having been disposed of, the great artistical genius of the man began to be displayed—where it was acquired is a mystery. His education in this direction was nothing—he has never been on the continent, nor has he associated with artists, except in connection with his own enterprises. We attribute much to a visit to Edinburgh; but the fact is, he rose a self-taught genius, of wonderful powers and taste, as well as enterprise. Let us now only briefly and cursorily glance at his creations.

Every stranger in Newcastle is struck with the first sight of Grey Street,—I much wished for my wife when I first saw it; I wanted to vent my emotions and eloquence on the genius of Grainger. The ground floor fronts are of glass for shops, otherwise you might take Grey Street for an avenue of palaces, which it had taken a century to erect. It is indeed astonishing that this row of shops, and warehouses, and inns, should spring up within *three years*, and should afford to the eye the same impression as a line of palaces in Vicenza—and this done by a former charity boy!

The erections which compose Grey Street, and the eight other new streets, are of a perfectly uniform colour, and the decorations are of solid stone. Grey Street has the advantage over Regent Street, London, not only in the richness of its architecture, but

also in the value and beauty of the materials employed, and the superiority of the fine stone of this neighbourhood over brick faced with stucco. But if we have not the stone in London, we have the people, which Grey Street has not—ladies, too, would say *we* have the shawls.

I may remark that Grey Street is 400 yards long, from 70 to 80 feet wide, and curvilinear in form. The houses are four lofty stories high, with a basement story of cellars; the sections, formed by cross streets, comprise separate designs. Of one part—the west side—consisting of three ranges of buildings, the architecture is Corinthian in character, and derived from the interior of the Pantheon at Rome. The second range is after the temple on the Ilyssus at Athens, and the Ionic columns are twenty-two feet high. The third compartment comprehends the great Central Exchange; this building must have a few words in particular from me.

Grainger was in one way like the man in the Arabian Nights' tale, who would go about giving people new lamps for old ones. Grainger would give the people and the corporation new houses for old ones; and yet, strange to say, he encountered most formidable difficulties in persuading people to let him give them a fine building for an ugly one. For six years were corn-dealers exposed to wind and weather, in spite of their own and Mr. Grainger's desire, that they should be sheltered and splendidly housed. At last they applied earnestly to him, and he erected for them a magnificent Exchange, and offered it to the corporation as a free gift, on condition of its being used as a corn-market. The corporation, however, were bound to another building; and what a building—poor, low, encroaching; and for this Grainger's noble offer was refused!

The great Central Exchange now affords a fine place of general meeting, and includes a news-room, coffee-room, and hall of conference. There, too, the viewers and the colliery people were wont to meet periodically, and there I have met and conversed with the various viewers and agents, one after another. This mass of building is the most conspicuous in the town, from its central situation and the magnificence of its design. It is alto-

gether lighted from the top. The interior measurements are 150 feet by 95 feet, in a semicircle of 75 feet radius. The roof is supported by 14 columns of the Roman-Ionic style, 12 of them forming a semicircle within the room. These columns are 25 feet in height, the base and capitals are painted white, and the shafts in imitation of Sienna marble. The wall which forms the diameter of the semicircle, is adorned with pilasters of the same order as the columns.

There are five entrances, and the doors are richly ornamented. The floor is tesselated, its material being a highly-polished dark stone, relieved by white tiles. The roof is formed of radiating principals, springing upon a curved rib from the entablature over each of the twelve columns which encircle the centre platform.

On entering, the effect of the whole, from the beauty of its form and proportions, and its ample and advantageous light, is exceedingly striking. There are now more than 1600 guinea subscribers to the Central Exchange, and Mr. Grainger remains its proprietor. We should like a museum after the same model at our residence.

Space would fail us in following Mr. Grainger—ay, and breath too, at his speed. Let us pause a moment at the centre of the north end of Grey Street, at its union with Grainger and Blackett Streets, where stands the Grey column. This column was erected by public subscription in honour of Earl Grey. A statue by Bailey surmounts the column. The column not only forms a fine finish to this magnificent street, but it is a striking object in approaching Newcastle in every direction.

Thus much for Grey Street. But Richard Grainger has also built Grainger Street, 300 yards long and 66 feet wide; Market Street, 190 yards long and 66 feet wide; and Clayton Street, 516 yards long, and Clayton Street West, 220 yards long by 62 feet wide. These two streets consist of large private houses. Other streets of lesser length are Grainger's work. All the streets show fronts of polished stone in varied designs. Thus there were nine new streets added to the town in the course of five years.

It is proved by calculations, that in this time nearly a million of property has been added to the value of the town in five years

by one man! The value of the property in the town is rising too. Two thousand workmen have been employed by Mr. Grainger at one time; and the population of the town is at this time increasing at the rate of 1500 a year. He is still active. He builds houses as fast as they are desired. He now erects the houses to a certain stage, and then finishes at the pleasure of a tenant. He has purchased the great Elswick estate, and paid £200,000 for it. It contains natural and mineral wealth of various kinds, and a plentiful spring of water, which will supply the whole town. He has a plan comprehending the junction of several railroads, the formation of extensive quays, the erection of ranges of manufactories, and on the high ground behind, of villas and terraces So that we may sing, in Newcastle dialect—

> Where canny Newcastle will gan to at last,
> Is far ayont maw understanding.
> But if it gan on as its duin for years past,
> It'll suin about Hexham be landin'.
> For toon within toon, and street after street,
> Grainger pops up—without iver heedin'
> How they're to be fill'd, unless some new leet
> Shows us how to be filled without feedin'.

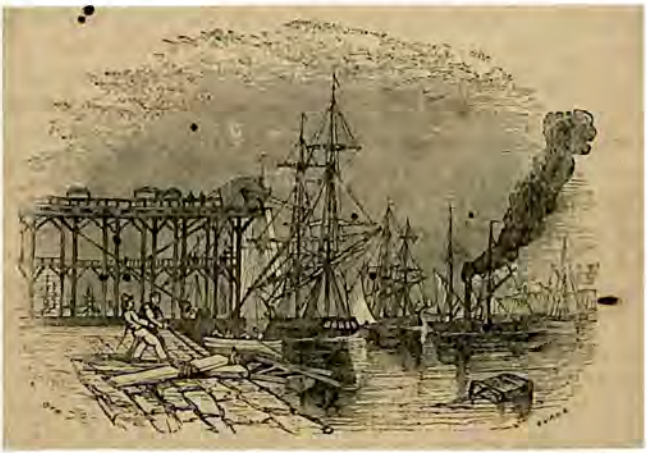
FIRST AND GENERAL ASPECT OF THE COLLIERY DISTRICT.

This neighbourhood, and far around it, have now for centuries been bored and excavated to furnish the most unparalleled supplies of this mineral fuel; and every year greater and greater demands are being made on the black mass of its subterranean wealth. "When you get into the bishopric of Durham, going northward (to Newcastle), you begin to see tall engine-houses, and vastly tall chimneys, breathing into the sky long black clouds of smoke. You hear groans, and whistlings, and numerous unearthly sounds around you. These engine-houses contain those great steam-engines that work the coal-mines; and those noises proceed from pulleys, and gins, and railways, and other industrious instruments for raising and conveying away the coals. As you get into the country nearer Newcastle, all these operations—these groanings and wailings—these smokes and fires—increase upon

you. Here you pass one of those tall engine-houses that you saw in the distance, with its still taller chimney hoisting into the sky its slanting column of turbid smoke. You now see a huge beam, protruding itself from the upper part of the engine-house, like a giant's arm, and alternately lifting itself up, and then falling again. To this beam is attached the rod and bucket of a pump, which probably, at the depth of some hundred yards or more, is lifting out the water from the mine, and enabling the miners to work, where otherwise it would be all drowned in subterranean floods. Or you see a great beam suspended from its centre, and elevated aloft on a proper support, wagging its ends alternately up and down, and up and down, with that busy and whimsical air which has obtained for it the name of a *whimsy*. This is performing a similar operation by a different contrivance. Then, again, those huge engines are at work whirling buckets down into the deep shafts for coal, or whirling the colliers themselves down to get the coal. For two or three hundred yards down a hideous gulf into the bowels of the earth are they sent, with a rapidity which to the stranger is frightful, to their labour, and pulled up again, after its performance, to daylight as fast. All this time these great engines, of perhaps 200 horse power, are groaning and crying over their toils like condemned Titans; and the wheels and pulleys that they put in motion are singing and whistling lamentably, like so many lesser spirits doomed to attend on their labours. Then you see buckets of coal emerge from the mouth of the pit, and immediately by self-agency run away, empty themselves into a waggon or boat, and come back empty and ready for a fresh exploit. Then, as you advance over the plain, you see a whole train of waggons loaded with coal, careering by themselves, without horse, without steam-engine, without man, except that there sits one behind, who, instead of endeavouring to propel these mad waggons on their way, seems labouring hopelessly by his weight to detain them.

"But what is your amazement when you come in sight of the river Tyne, and see these waggons still careering on to the very brink of the water!—to see a railway carried from the high bank and supported on tall piles, horizontally above the surface of the

river, and to some distance into it, as if to allow those vagabond trains of waggons to run right off, and dash themselves down into the river. There they go, all mad together! Another moment, and they will shoot over the end of the lofty railway, and go headlong into the Tyne, helter-skelter! But behold, these creatures are not so mad as you imagine them. They are instinct with sense. They have a principle of self-preservation as well as of speed in them. See, as they draw near the river, they pause —they stop; one by one they detach themselves, and as one devoted waggon runs on, like a victim given up for the salvation of the rest, to perform a wild summerset into the water below—what do we see? It is caught. A pair of gigantic arms sepa-



rate themselves from the end of the railway. They catch the waggon; they hold it suspended in the air; they let it softly and gently descend, ay, softly and gently as an angel dropping to earth on some heavenly message, (I fear the angel of coal comes the other way,)—and whither? Into the water? No; we see now that a ship already lies below the end of the railway. The waggon descends to it; a man standing there strikes a bolt—the bottom falls, and the coals which it contains are nicely deposited in the hold of the vessel! Up again soars the empty waggon in

that pair of gigantic arms. It reaches the railway; it glides like a black swan into its native lake, upon it, and away it goes as of its own accord, to a distance to await its brethren, who successively perform the same exploit, and then, joining it, all scamper back again as hard as they can over the plain to the distant pit." Very well described, William Howitt! It is astonishing how a poet can find poetry in any thing—in a coal-pit, and in a river-side coal-staith, in coal waggons, whimsies, and steam-engines; in all above, and all below ground.

THE RIVER TYNE—ITS COURSE, ITS COALS, ITS KEELS AND KEEL-MEN.

What a river this Tyne* is, in itself and its traffic, its course and its carryings! It is not indeed so broad and majestic as the Thames or the Mersey; but it is nevertheless a fine river. Before it reaches Newcastle it has run from the mountains of the west and the north, through a wild and somewhat picturesque country, between high and pleasant banks, and amidst localities marked by historic events of highest national interest. On bold heights overlooking it, stand the shattered castles of the once mighty Baliols, Umfrevilles, the Herons, the Riddells, the Blenkinsops, the Blacketts, the unfortunate Derwentwater, and other warrior races now declined. Along its banks, Romans, Britons, and Scots have left their memories, and traces of their abodes and battles there. Corbridge, and Hexham, and Stella Haugh, are names not to be forgotten on its banks. This is enough for war; doubtless its waters were often stained with blood—now, however, they are more profitably, as well as more innocently, dyed with coal. With its waters you may associate the names of Thomas Bewick, the celebrated wood-engraver, and the truly venerable Bede. Both theology, however, and engraving, as well as war and feudal grandeur, have given way to coal; and in connection with the prosperity which the vast development of

* The Tyne originates from two small streams, called the North and South Tyne, which unite a little above the ancient town of Hexham, at about thirty miles from the sea.

coally wealth has occasioned all along its banks, downward from Newcastle, you may behold all kind of manufactories and commercial establishments located upon it, or near it.

Sailing or steaming down the Tyne to Shields, you may catch full or side views of bottle houses, flint-glass works, crown-glass houses, plate-glass works, lead works with a shot tower, founderies and iron-works, steam-engine manufactories, chemical works and alkali works; and all indeed that can reflect, cleanse, or convey, and perhaps cure—the body of man, as well as very much that will interest his mind. The coal, however, is its great burden, and its chief glory, if any thing that is black can be a glory. Along its margin, down from Newcastle, you see more of coal than of nature. You see those railways which convey the coals from the pit all hastening to end at the Tyne. You see those staiths, and their vast extent of woodwork, of which we speak more minutely elsewhere. You see standing at those staiths vessels and boats, loading or laden with coal, and carrying an aspect of coal in once white sails, and once clean oars, and once washed human beings.

On the Tyne, the coals used to be carried from the staiths to the ships almost entirely in a kind of oval vessels, called *keels*, of which considerable numbers are still employed in bringing down the produce of the collieries situated above Newcastle bridge (which the sea-going craft cannot pass), to the ships lying about Shields, and which do not load at any of the staiths between those places. A keel is considered to contain by admeasurement eight Newcastle chaldrons. The coals, when large, are generally piled in the vessel according to convenience; and then small deep side-boards are added, within which the coal is heaped up; but in some cases, where the coal is tender, tubs are used. Eight of these tubs being placed in a keel, go to the vessel, into which the tub is lifted by means of a crane, and when immediately over the hatchway, the trapdoor is loosened, and the contents let down into the ship with little injury. The keels themselves are built after an ancient model, and in connection with the men that man them, and their arrangement, present striking features in the navigation of the river. Brand, in his

History of Newcastle, describes the method of navigating the keels pretty accurately. "One man on each side of the vessel going towards the prow, puts down his pole to the bottom, in a position inclined towards the head of the keel, at the same time thrusting against it forcibly with his shoulder, and walking down on the gangway towards the stern as the keel moves under him; by this method the keel gains a tolerably quick and even course on the water. Having walked the whole length of the vessel, they pluck up the great oars, which they call *puys*, return hastily to the prow, put down the *puys* again, and thrust as before." Often and often have I watched this curious navigation, as I have sailed down the Tyne to some pit nearer the sea than Newcastle. Dr. Stukely in his *Itinerary*, about the year 1725, describes the method of navigating keels in a similar way. And Pennant speaks of the keels as "strong, clumsy, and oval vessels, that carry about twenty tons apiece; they are navigated with square sails, but generally by two very large oars, one on the side plied by a man (generally two men) and a boy; the other at the stern, by a single man, serving both as oar and rudder."

The keelers, or keelmen, are a remarkably hardy, and very peculiar class of men, in many respects very different from the pitmen. In seeing the two men together, you observe a very great contrast both in figure and carriage, of course to the disadvantage of the poor labourer underground, who, however, probably gets the most money. We find the "keelers" mentioned under that name so early as 1378. *Keel*-bullies is a term used for this class of watermen, though the name *bullies* is probably derived from an obsolete adjective *boolie, i. e.*, beloved; and is used therefore in a good sense rather than bad. *Boolies* is a common name amongst old colliers for *brothers*. Brand mentions a pauper, who, in giving an account of himself and family before the officers of a parish in Newcastle, for the purpose of obtaining a settlement, mentioned it as a matter of great self-satisfaction, that his father had brought up six of his sons *bullies!*

Speaking of the keelmen, Mackenzie says, "The keelmen are a hardy and a laborious class of men, and are distinguished for

their great muscular strength. Few employments require greater exertion than theirs, nor could they perform it were they not supported by nutritious food. Accordingly, the hardy keelman never goes aboard the keel till his basket is stored with a good joint of meat, and a substantial loaf, generally of the best flour, which, with a bottle of beer, form his usual diet. The flesh, which is of the fattest kind, is sliced, laid upon a piece of bread, and then cut into convenient bites with a knife. Seated round the *huddock* or cabin of the keel, and covered with perspiration and coal-dust, they enjoy their meal with peculiar cheerfulness. One boy is attached to every keel, and he is under the immediate orders of the skipper (the chief person on board); but each of the keel's crew contributes a small portion of his victuals for the boy's support while aboard. From the practice of hailing one another on the river, especially during the night-time, they acquire a loud and vociferous manner of expressing themselves; yet their conduct is uniformly civil and exemplary, and they are gradually losing the blunt roughness by which they have been characterised. They are remarkably friendly to each other, being all *keel-bullies*, or keel-brothers."

The fund which the keelmen have established for mutual relief during sickness and old age, and also for the relief of their widows and children, is highly honourable to them. They have founded and supported an extensive establishment in Newcastle, called the "Keelmen's Hospital." Their wives and daughters are also well fed, healthy, stout, and strong. They usually wear woollen bedgowns, with an excellent silk kerchief of various colours thrown carelessly over the shoulders, and one or two others tied round their heads. Some of these women sweep the keels, and have the coal-sweepings for their pains. These women are called *keel-deeters*, or *keel-doctors*.

You may always meet some or many of these keels, with their crews, on the Tyne, and often a whole fleet of them, either going down to ship, working away with their *puys*, and calling out most vociferously to some unfortunate boat in the way; or they may be returning with empty vessels, still cautious and clamorous, but more easily pacified.

In discharging these river craft into the regular traders above Tynemouth, some of the coals are frequently scattered overboard, and these, together with a considerable quantity sometimes brought up with the flowing tide of the German Ocean, form the perquisites of a number of poor people, who, with their little cobles, ropes, and nets, are to be seen constantly dredging for them in the Tyne between North and South Shields. A similar practice is observable at the mouth of the river Wear. The persons waiting about for the rising and recession of the tide, when small coals are expected to be left on the sands, present a scene of considerable activity and entertainment. In their anxiety to be foremost, they frequently pursue the receding surge too far, and by its sudden reflux become drenched, and sometimes immersed to the middle in water. Formerly, as many as 500 persons at a time have been witnessed pursuing this occupation; but now new manufactures have given more employment to the poor, and the coal-gatherers are fewer. "Where do all these coals come from?" I have asked myself in wonder. The common opinion, that they come from ships sunk at sea, is scarcely tenable, for they are there when ships are not sunk; nor can many come from the keels. Do they come from any under-sea coal-basin, the basset edges of which are abraded by the waves? Such an idea has been started; will any one follow it—not under the ocean—but in his study?

The keelmen have been famous for a song called the "Keel Row;" and, as I often heard them singing, I fancied they were singing snatches of this song, which runs thus—

THE KEEL ROW.

"As I cam thro' Sandgate, thro' Sandgate, thro' Sandgate,*
As I cam thro' Sandgate, I heard a lassie sing,
Weel may the keel row, the keel row, the keel row,
Weel may the keel row, that my lad is in.
He wears a blue bonnet, a blue bonnet, a blue bonnet,
He wears a blue bonnet, and a dimple in his chin;
And weel may the keel row, the keel row, the keel row,
And weel may the keel row, that my lad is in.

* Sandgate is a lane in Newcastle.

Some other keelmen's songs which I discovered, are not exactly poetical or polite; but another stanza of another edition of the above song may be safely added :—

'He's ne mair of learning
Than tells his weekly earning;
Yet reet frae wrang discerning,
Tho' brave, no bruiser he.
Tho' he not worth a plack is,
His own coat on his back is,
And none can say that black is,
The white o' Johnny's ee!"

To conclude our notice of the Tyne river, I add an appropriate stanza from a Newcastle song :—

"Hail, Tyneside lads! in collier fleets,
The first in might and motion;
In sunshine days or stormy neets,
The lords upon the ocean.
Come England's foes—a countless crew—
Ye'll give them all a scummin',
And myek them a' the day to rue,
They glibb'd their jaws at Gunnin."

I regret that the popular literature is not better than the above shows it to be. It is strange that it should be prized.

I shall now say a word or two in explanation of

THE STAITHS, AND MODE OF SHIPPING THE COALS.—FLEETS, STEAM, AND RAILWAYS.

It is a remarkable natural advantage, that the great northern coal-field is intersected by three considerable rivers, in consequence of which fact, the whole district possesses an easy, cheap, and expeditious mode by which its produce of coal may find its way into the general market. These three rivers are the Tyne, the Wear, and the Tees, each of which is admirably adapted by its volume of water, its tides, and harbour-room, for these purposes. The large collieries in the vicinity of the river, have each a run-

ning railway in the most direct line to the river's banks. To procure and maintain the "way-leave" for these lines is an expensive item. Upon these railways, the coal waggons move in trains of from ten to thirty or more in number, according to the extent of the works, or the existing demand for coal. The nature of the power which puts them in motion, depends in some measure on the distance they have to travel, and the inclination or other peculiarities of the surface. On those which are perfectly level a locomotive steam-engine generally heads the train, and drags it to its destination with startling rapidity. On other railroads which have a regular descent the whole way, the waggons are impelled by their own gravity, and, by the aid of a long rope and a series of pulleys, drag up the empty train, which in its turn, when again descending with a load, draws the other to the pit in like manner.

When the railroad is carried up an ascending plane, the train is drawn up the ascent by a winding engine stationed at the summit of the incline. In many small establishments, and in some which are situated very near one of the rivers or the coast, horses are employed to draw the trains of coal-waggons; and in others a combination of all those methods is pursued. Those collieries which are situated several miles from both the rivers or the coast, have frequently to pay sums amounting to £400 or £500 a year for the right of carrying their communications through private property which may intervene between the pit and the place of loading. There is a map in which the chief collieries shipping by the Tyne are marked, and dotted lines issuing from them, show the course of the railways by which they communicate with the river. The map, having been constructed for this purpose, displays a complete congeries of collieries, interlaced as it were by mining railways, until the whole district looks as if it was riddled with pits, and then bound together by railways.

In looking over the map, at this moment, I see a line of railway dotted in, which I shall not easily forget. It runs into the Tyne near Howden, and begins and leads from a colliery called Cramlington, high up in the country. It is a long line, and has

many occupation bridges thrown over it, to carry paths and roads across it, as in our railways in general. These bridges are built so as *just* to allow the coal waggons to run clear under their arches, not leaving more than a shaving between them. Two or three stationary engines wind up and let down the trains. Now, I wanted to visit Cramlington pit, and others thereabouts; and thought I might save a special conveyance (for you must hire a gig, or post to all the collieries, if they lie out of the public rail or river line), if I could get permission to ride in one of the coal waggons when empty on its return. This I easily got, but not so easily got into the waggon; it was deep, broad at top, and narrower at the bottom, and dreadfully coally. I had, however, no time to hesitate, and I did manage to get into one, and stood upright in it. Never having been on such a line before, I knew little and thought nothing about the occupation bridges, and elevated myself to look round, and was much pleased with the view I got of the country, as the train began to approach the summit of one of the inclines. In a twinkling I saw that we were approaching a bridge, and that *my head* would be taken off without doubt if I could not bend in time! It was scarcely a twinkling between the thought and the bridge. I shrunk in inexpressible terror into the waggon, but not before—whiz—whiz—whiz—and in a crack of a moment away went my fine London *hat*, and most providentially *not* my head. The bridge cut the hat into how many pieces I dont know, for I never recovered it. I bought a pitman's cap at Cramlington.

But having escaped decapitation by a bridge, let me proceed with the staiths. At the end of such a railway as I have just described, and overhanging the river, a large platform of wood is erected, which is called a staith. Upon this the waggons laden with coal are brought to a stand, previous to the discharge of their contents into the holds of the ships which lie at anchor underneath. Each waggon contains about two and a-half tons (fifty-three cwt.) of coals, and when the number of waggons has been entered by a clerk appointed for that purpose, they are placed, one at a time, on a square open frame, which, on the withdrawal of a bolt, is immediately moved from the staith by

machinery until it is suspended over the main-hatchway of the vessel. A man also descends with it (and a picturesque appearance his descent has), then unfastens a latch at the bottom of the waggon, which, being made to turn upon hinges like a door, immediately opens, and the whole of the coal in the waggons is cleanly poured into the hold. To facilitate this operation, the sides of the waggon converge towards the bottom, and are lined with smooth iron plates. (I found them any thing but comfortable on the Cramlington expedition.) Attached to the suspending machinery are two counterpoising weights, which, being less heavy than the waggon laden with coal, do not impede, but add steadiness to its descent. But the moment the coal is discharged their gravity draws up the waggon to the staith. This mode of loading the vessels is both complete and ingenious. In an excursion on the Tyne, between Newcastle and Shields, the perpetual ascent and descent of the waggons in this manner forms a very curious and interesting spectacle to the stranger; and indeed, though fully accustomed to it, I never witnessed it without interest. To see the coal-waggons run swiftly to the river, stop in a moment, and go down with the descending man, like Curtius leaping with his horse into the gulf, was very striking. The self-complacence and composure of the man while describing so large a circle, or arc of one, and the apparent knowingness of the coal-waggons, the noise of the opening of the unlatched waggon-bottom, the loud rush of the coals into the hold, the returning clack of the waggon bottom, and the upward sweep of man and waggon, were to me far more interesting than any sight or sound at Cremorne, on the banks of the Thames.

In situations where, owing to the height of the cliffs, this mode of emptying the coal waggons would be inconvenient or impracticable, a large spout is used, and the vessel is brought under the aperture at the lower end, so that the coal emptied at the top passes along the spout, and is thus discharged into the ship's hold. At Seaham Harbour the height of the staith is perhaps forty feet above the deck of the vessel, and to diminish the force with which the coal would descend the spout from so great a height, there is a trap-door at the lower end, by which

the force of its descent is diminished, and it reaches the hold without injury to the vessels.

Seaham harbour itself has in reality arisen out of coal, though in appearance it rises out of the sea; for it has been formed, within fifteen or twenty years, by the Marquis of Londonderry, in connection with his collieries. Seaham is near Sunderland, and a railroad leads from it to the South Hetton Colliery, a distance of about four miles, passing in its course across valleys, and through passages cut in the solid rock. Not many years ago (say at most twenty), there did not exist at Seaham the slightest natural appearance of a harbour; but it is now a most convenient shipping station for colliers to receive their cargoes in safety. Two piers have been constructed, and a village has sprung up on the site where these improvements have been so successfully undertaken. I well remember visiting Seaham harbour with the late Mr. Buddle, the eminent miner for the Marquis of Londonderry's collieries. He drove me over in his gig, and a long chat we had on all pit matters—I endeavouring to draw him out, and he draw me in—that is, to admissions of the excellences of all present pit arrangements. I well remember seeing a train of loaded waggons drawing a train of empty waggons up a declivity, or on an inclined plane, on the South Hetton Railway; and noise and clatter enough they made to frighten any horse except Mr. Buddle's, who, like his master, prided himself in acquaintance with colliery business.

Vessels do not enter or clear at North and South Shields for the Tyne trade, but at Newcastle, of which those are the out stations. The number of ships registered at Newcastle was some years ago 1100, and their tonnage amounted to 221,276 tons. A collier makes, on an average, nine or ten (and sometimes more) voyages to London in a year; and the arrivals in the Tyne annually are not less than 13,000 or 14,000; 10,000 of which are on account of the coal trade.

Sunderland is the great shipping port of the river Wear. The number of its registered vessels has been more than doubled within the last fifty years, being 625 in the year 1829, and the tonnage 107,880. The average number of vessels quitting the port has

been 176 per week, or 9152 in a year. The amount of coal sent abroad from Sunderland, is about 176,000 tons annually; and in 1833 it supplied the London market with 667,787 tons of coal, besides enjoying, with Newcastle and other ports of the north, a share in the general coast-trade of coal.

Stockton-on-Tees is a thriving port, and its trade in coal increasing. The three rivers are the great courses of the northern coal-field, in the distribution of its products and treasures.

Hartlepool is situated at the extremity of the northern arm of Tees' bay, and embraces within its limits the docks of the Hartlepool Dock and Railway Company, and those of the Stockton and Hartlepool Railway Company. Here are a dock 650 yards long, by 150 yards wide, and another of 280 yards long, by 130 yards wide, with entrance harbour 300 yards square. Hartlepool is made by the coal trade, and the "drops" for shipping at that place are of superior construction.

A very fine marine picture may sometimes be witnessed from a bold promontory on the coast. If you take your station on Tynemouth Priory, a well-known ruin placed upon a rock jutting into the sea, when the wind has changed after long-continued easterly gales, you may see many hundred vessels, mostly colliers, put to sea together, rejoicing at their freedom after having been long wind-bound. On one occasion some three hundred vessels, all laden with coal, were observed making sail together in a single tide, and distributing themselves over the ocean with their prows turned in almost every direction. Some were sailing southward and coastwise, for English ports, for the Channel, and for the southern countries of Europe; others were pointing northward for Scotland, and the Norwegian coast; others steered due east for Denmark and the Baltic; and all were sinking deep in the water, weighed down by that mineral fuel which does more for our national advantage than auriferous sands and Peruvian or Mexican silver mines. These dingy and crawling craft are, or were, the "nursery of the British seamen;" for being constantly at sea, winter and summer, they necessarily train up a race of hardy and practised mariners. Very recently the newspapers have given an account of the perils of a fleet of these

colliers, and the striking narrative of one hardly escaped from shipwreck. But the naval nursery stands or floats in danger of abolition. A new line of clipper screw-steamers have been started, designed to sail three feet to one of the lumbering collier brigs, and at once to reduce the time and cost of transit. These again have to contend with serious rivals—the railways—which convey coals at one farthing per ton per mile, free from vexatious dues and duties, privileges and monopolies, all which hang over the vessels like birds of evil omen. At least let one collier brig be preserved as a specimen of things that were. It may soon be a mere curiosity.

The first *steam collier* entered the Thames in September, 1852, having run the distance from Newcastle in 48 hours. It is said that in future 40 hours will suffice, when the stiffness of the new machinery shall have worked off. She consumed eight tons of coal on the voyage, and brought 600 tons as cargo, the whole of which was discharged in the day, and the vessel went back for a further supply. Apart from the facilities for loading and unloading, the certainty with which these steamers will make the passage, will benefit the citizens of London, by saving them from the rise in price which inevitably follows the fall of the thermometer in December.

The English coal is now sent to Vienna, and can be sold there cheaper than the Austrian coal, besides being far superior.

ANNUAL COAL TRADE OF THE TYNE, AND WEAR, AND TEES.

The annual coal trade on the Tyne and Wear rivers cannot be given as a constant, but must, for manifest reasons, fluctuate considerably. Taking it as it was some few years ago, including the home consumption, it was in round numbers not far short of four and a half million tons, which may probably form about one-fifth part of coal consumed in, and exported from, Great Britain. Mr. Taylor, before the Lords' Committee, stated the amount, coastwise, sent from the two counties to be 3,300,000 tons, and the home consumption to be one-fifth, or 660,000 tons, making the total of the northen district to be 3,960,000 tons which quantity supplies about five millions of persons.

From a Parliamentary Return, June 1, 1849, I found the subjoined table of shipments for 1848, from the Tyne river, and its two ports of Newcastle and Shields :—

TYNE RIVER COAL TRADE.

In the Year	Coastwise.	Foreign.	Total.
	Tons.	Tons.	Tons.
1848.	2,488,383	1,111,461	3,599,844

In 1846, no less than 5272 vessels cleared out with coal for foreign ports *only*.

The river Wear is, like the Tyne, used as a natural dock, but not on so extensive a scale, for there are only three feet water on its bar at low water. The entrance is between stone piers, and from this entrance to the high level bridge of Sunderland, connecting both sides of the river, the channel may average 60 yards. The amount of shipments of coal in 1848, was as follows :—

WEAR RIVER COAL TRADE.

In the Year	Coastwise.	Foreign.	Total.
	Tons.	Tons.	Tons.
1848.	1,911,812	498,162	2,409,974

To the above it is only necessary to add the shipments from Stockton-on-Tees and Hartlepool, to present a complete view of the coal trade of the north for one year, 1848—

TEES RIVER, INCLUDING STOCKTON AND SEAHAM HARBOUR.

In the Year	Coastwise.	Foreign.	Total.
	Tons.	Tons.	Tons.
1848.	556,950	105,094	662,044

HARTLEPOOL SHIPMENTS OF COAL.

In the Year	Coastwise.	Foreign.	Total.
	Tons.	Tons.	Tons.
1848.	922,568	243,060	1,165,628

Places of shipment also exist on the coast at Wirkworth, on the Coquet River, at Ryhope, at Blyth, at Seaton, and other places high up in Northumberland, most of which do some considerable business.

THE GREAT NORTHUMBRIAN AND DURHAM COAL-FIELD.

A recent French author has well remarked, that three persons travelling to Newcastle-on-Tyne in different directions, would receive totally distinct impressions of the nature of the industrial occupation of the people. One traveller, for instance, coming by the railroad from Carlisle, would cross an agricultural district, and might scarcely notice the fact that any commercial value attached to it, or that any thing was capable of being exported, except perhaps the lime obtained by the burning of the mountain limestone of the district. Should his journey be made by night, he may have been struck by the appearance of flame vomited from the chimneys of the glass-houses near Newcastle, and those at Lemington; but a few coking ovens would present the only external indication of the real nature of the riches that abound in that part of England.

Let another person be travelling from London by the steamboat, and he would probably admire and wonder at the vast multitude of vessels engaged in the coasting trade of Britain; and his attention, perhaps, would be mainly directed to the vessels engaged in that branch of trade he was about to investigate. But it would not be until his arrival at the mouth of the Tyne, that he could form a sufficient idea of the true commercial importance of the northern counties—not until he had observed

the numerous and well-built vessels in that river, and had seen the coal raised from a vast depth below the sea-level, and deposited on board these vessels, and his enthusiam had been kindled by the animated appearance of the port of Newcastle, would he fully feel his own littleness, and his inability to comprehend in all its detail so vast a development of national industry.

But the third traveller coming from Birmingham, and who had traversed the series of coal formations which extend from the middle of England northwards, and which he would also cross in the county of Durham, would, beyond doubt, have the best idea of the riches of the country. Throughout his route he could not but have noticed that every thing is sacrificed to the coal, and the great works in operation underground would be indicated to him by the immense apparatus erected on the surface, for the extraction of the mineral riches, and for the drainage and ventilation of the mines. He would have seen the innumerable tram-roads, and their long succession of waggons laden with coal. He would have inquired the meaning of the numerous extensive towns, built of uniform habitations, visible at intervals along the road; and he could hardly perhaps suppress his astonishment at learning, that they were all the dwellings of the thousands of pitmen. But the impression made upon each of those three travellers must be united, if one would acquire even a feeble and imperfect notion of the chief points of interest which the coal-mining district of the north of England offers to the intelligent inquirer.

The great Newcastle coal-field is bounded on the north by the river Coquet (a capital river for the angler), and on the south it extends nearly to the Tees river. Thus, its extreme length is about forty-eight miles, and its extreme breadth measures twenty-four miles; but its area cannot be calculated at more than about 800 square miles.* It is intersected by two navigable rivers, the Tyne and the Wear, on the former of which is situated the town of Newcastle, and on the latter the city of Dur-

* *i.e.*, 243 square miles for Northumberland, and 594 square miles for Durham, making 837 square miles for the two counties. Some have calculated the *productive* area of this coal-field at 780 square miles. (Dunn and Taylor.)

ham. The whole field is unequally divided by a great fault crossing the district a little north of the Tyne, and throwing down the strata on the northern side (or raising them on the south), to a perpendicular distance of 90 fathoms. This fault we have before alluded to as the "Great ninety fathom dyke," and it is locally called also, the "Main dyke."

There are as many as forty distinct beds of coal in this coal-field, but only eighteen of them are of sufficient importance to be considered as workable and remunerative. The most valuable bed or seam is called the *High Main*, and is about two yards thick. The next in value is the *Bensham* seam, which is remarkable for its excellent quality as a domestic coal, and for the enormous quantity of gas evolved from it in the mine. The *Hutton* seam is of very good quality, and is extensively worked. The other seams are very valuable. Therefore, collieries are established chiefly with reference to one or more of these three seams. One of the things that most astonishes a stranger to the subject and the place, is the immense establishment and apparatus brought together in a large colliery for working seams so thin as the above named. In looking over the sections of the strata sunk through in these collieries, you see perhaps main-coal, or high-main, six feet; Bensham, one foot six inches, or three feet; and yet for such thickness or thinness you must erect all this apparatus. At this moment I look over several sections of the coal-beds, and I find such thicknesses as, high-main six feet, low-main three feet, Hutton seam four feet, and three feet six inches, and five feet nine inches; and such is a specimen of the whole district.

"What, then," it may be said, "can the available produce be from seams so thin?" Now, the available produce of ordinary mining may be assumed as three-fourths of the gross contents of the coal in the ground, and of these three-fourths a certain proportion of small coal, over and above that which is left underground. If, by an improved mode of working, these available proportions can be amended, of course it amounts to a reduction of the ordinary rent charged by leasing the coal per acre. You will see this in the subjoined table, and something too of produce.

	TONS.
A Cheshire acre of coal-mine said to contain (assumed per foot thick of coal)	3000
Suppose left underground in pillars and small coal, ...	800
Then the available quantity of coal is per acre, ...	2,200
Supposed small left at surface, or consumed in Colliery Works, &c.....	600
Then total produce of large coal, per foot thick, per Cheshire acre, is	1600

A Cheshire acre contains 10,240 square yards, while the statute acre contains 4,840 square yards.

But the same seam of coal may become deteriorated, and not generally valuable in all places. Thus, the high main seam, one of the very best seams on the Tyne, if not in the whole north of England, becomes injured and inferior as it proceeds in a south easterly direction, by being intermixed with a band of coal of inferior quality, with an admixture of iron pyrites, &c. The high-main coal, for example, occurs in the Manor Wallsend colliery, near South Shields, at a depth of 125 fathoms.* It there consists of five layers; the second and fourth, consisting of bands of coals of an inferior quality, making together one fathom and five inches. This deterioration of the stratum is called the Heworth band, as it commences in the workings of the colliery of that name. Thus, even the very best seams are not all best coal in the seam. How very small then is the proportion of available coal to the beds called the coal measures. It is thought that the actual quantity of coal in the Newcastle coal-field does not amount to more than four per cent. of the whole mass of the strata; of which mass various kinds of sandstone form about 30 per cent.; and strata in which siliceous earth predominates, about 44 per cent.

* A fathom is equal to six feet. I use feet and fathoms indifferently, as in the north. The reader has only to multiply or divide by six, as the case may be. It is unfortunate that the terms feet, yards, and fathoms, are used so indifferently, but so it is.

HOW LONG WILL THE COAL LAST? NO MINING RECORDS. COMPUTATIONS.

It appears that after suitable deductions the available beds of coal scarcely exceed thirty feet in thickness if placed together, even at the utmost; whilst the principal workable seams have been averaged by a competent authority at twelve feet thick.

Of the 837 square miles comprising this great field of coal, the portion already excavated is computed to exceed 105 square miles; and from a particular calculation it has been deduced that, according to the present issue of coal from the chief pits in this field, there remains enough to satisfy our posterity for 1700 years to come. Dr. Buckland, however, in 1830, limited the supply, at the existing rate of waste and consumption, to 400 years. As none of us will be alive to prove him a true or false prophet, we cannot speak accurately; but his calculations were based on the false assumption that there was no coal beneath the limestone. But many reasons lead us to view the supply of coal as practically inexhaustible for many centuries. It is not, however, improbable that as the nearest coal is first got out, more expense will be incurred in obtaining the coal in centuries to come. Such an increase of expense, however, may again lead to the opening of new pits, the greater development of old coal-fields, and the discovery of new deposits.

This question, as to the future supplies of coal, has often been asked and answered, and different answerers have replied differently; nor have the replies been always, or often, dictated by a comprehensive grasp of the subject. If the only data required were the superficial area of a coal-field, and the sum of the thicknesses of the several beds of available coal, nothing would be easier than to convert this into a term of years, by assuming some fixed or regularly varying rate of annual consumption. But *all* the coal in a given district cannot be worked in consequence of natural impediments, and will not be worked because of wasteful and unscientific methods of mining. Until records of mining operations are established for public reference, much of the working of coal is literally, in all senses, in the dark. Many

portions of country are now, owing to the above causes, left full of unattainable coal, and others are untouched from the dread of irruptions of the water in long-abandoned works. Again, beds of coal of inferior quality or thickness are left till the future scarcity of fuel shall render it profitable to work them; but this must take place under great disadvantages both to the miner and the consumer. The risks, dangers, and difficulties of the miners will be increased and increasing. Therefore however long the coal of Great Britain may last, its price must gradually rise, because the cost of its production, in relation to that of other articles of consumption, is necessarily on the increase. There can be no doubt that calm and well considered legislative action on this matter is very desirable—although, as the Hibernian maxim has it, "posterity has done nothing for us." Add to the above circumstances of consideration one other. It is a striking fact that no known district of coal in the British islands (except a small part of Ayrshire) is unwrought. Most of the coal-fields are covered by manufactures, and before long the geologists may be called in to decide as to the propriety of sinking for coal in situations where it does not appear on the surface. Perhaps it is spread beneath our feet in areas not less extensive than some of our largest coal-fields as we now know them. It *may* exist beneath the plains of Cheshire; but who will have the boldness to penetrate the red sandstone in search of coal that may be placed at an unattainable depth?

I now give the most recent and probable view of the solution of this disputed question.

It is estimated that the mean thickness of the workable coal over the whole area of the Newcastle Coal-field is about twelve feet, or four yards; and as the weight of the cubic yard of coal may be estimated at above one ton, it thus appears that there have not been less than about 10,000,000,000 tons of mineral fuel present in the whole field. It may be considered that about 5,000,000 of tons are at present removed or wasted annually, which would give a probable total duration of about 2000 years from the commencement of the workings. It is proper, however, to deduct one-eighth part as equivalent to the consumption up to

the present time, and thus there would appear to remain a quantity which would admit of the present supply being obtained for about 1750 years; other calculations recently made, arrive at 1184 years, and 1000 years as the minimum.

In estimating the quantity of coal in a given district, it is common and necessary to make a large deduction from the apparent surface area, to allow for accidents of denudation (or stripping of the coal by natural causes), injury from faults, and also for that part of the coal which may be thrown down below a workable depth.

DISCOVERY OF THE DURHAM COAL-FIELD BENEATH THE LIMESTONE.

A singular instance of sagacity in a geologist may be related of Dr. William Smith, the "Father of English Geology," who was the constructor of the first geological map of England. William Smith was a surveyor, and engineer, of remarkable natural acuteness. A great observer of facts, and a true Baconian, without knowing much of Bacon, he examined the district around Durham, in which, at that time there were no collieries. At that time, too, the Newcastle wise-men of the mines had a saying, "No coal under the limestone;" referring to the (magnesian limestone) limestone which covered most part of Durham. This was a local prejudice, like to that of the Somersetshire and Lancashire colliers—"No coal under the red earth." The wise men of the Newcastle mines, fancied they should have to bore through an immense thickness of this limestone, and would after all find no coal; but Mr. Smith examined the district himself, and saw that the limestone was an "unconformable" cover to the coal strata below; that is, that it lay upon the inclined edges as a book placed horizontally upon the edges of another book, standing under it vertically; or upright. He traced the coal strata in their courses, conjectured their rise under the limestone, estimated its thickness, and inferred from the whole of his observations, that the best seams of coal would be found at an attainable depth at Haswell, a few miles from Durham. The agent,

or "viewer," thought that if coal did exist there, and thereabouts, it would be of very inferior quality, as it was generally supposed the magnesian limestone impaired the quality of all coal that might be found under it. Smith, however, persuaded them to try for coal—they did, and found it,—and a certain proprietor of a certain colliery in the county of Durham, derives many thousands a-year from the verification of Smith's theory: not to say that very many other collieries have been opened in pursuance of the proof of this theory. Mr. Smith was wont to put on the aspect of a martyr of science when he added to this history, that he himself was never presented with any mark of the esteem and gratitude of the enriched coal-owners. "*Tulit alter honores.*"

This fact may be understood by a reference to our first illustration (p. 45), where, suppose the beds *a* to *l* to be coal measures, and to be covered at the surface, above the sea line, with a horizontal bed of magnesian limestone—then that would be the case of the Durham strata. Pierce that limestone bed, and you reach the coal beds (*a* to *l*) underneath it. If they had lain horizontally, like the covering limestone, they would have been chiefly unattainable; or attainable only after sinking previously through all the other strata.

UNSUCCESSFUL TRIALS FOR COAL.

This was an instance of the advantage of real science, founded upon the inductive principle. Our old friend, Smith, was a close observer of facts and phenomena, and hence his success. Ten times a day have we heard him boast of his success in this way. And he had just reason for boasting: for compare this history with the numerous histories of coal-trials by guess work, and the results are striking proofs of the value of a little geology. The brief information contained in the previous pages, would have saved many thousands of pounds spent in fruitless search for coal. Take an instance or two. Some years ago, ignorant people persuaded the Duchess of Dorset to expend about £10,000 in vainly searching for coal at Bexhill, in Sussex:—where any geologist

(as now instructed) could have at once pronounced that none would be found. Again, in 1839, a most extensive display of steam engines and shafts was made at the Kingsthorpe pits, about a mile from Northampton; a joint-stock company was organized to work the supposed coal underground, and only found there was none of any value; after they had sunk £20,000, as well as many shafts or bores. All this foolish expenditure had been made upon a mere imaginary expectation of coal. An uneducated well-sinker had bored through a bed of clay, which resembled the clay overlying coal, and a little lignite, or imperfect coal, had probably been found. This was enough—no experienced geologist was consulted;—a large amount of capital was subscribed by rich and poor—and the whole expended without any return—save that of empty buckets from the sinkings. Truth is said to be found at the bottom of a well—it was not so here—water alone was found where truth or coal should have been found.

The spot was about the middle of the oolitic formation, which is geologically very much more recent than coal strata. There are two districts in which small deposits of coal are found, apparently in oolitic strata, but they are very partial exceptions to the rule. We may say three instances—one north of the Humber, where the coal never exceeds sixteen inches in thickness; and a similar deposit is found at Brora, in Scotland, which stretches for several miles along the coast; and in East Yorkshire a carbonaceous series occurs in oolitic beds. Such exceptions, on so small a scale, may almost be said to confirm the rule, as regards this country at least.

We might point out places where other fruitless trials have been ignorantly made, as Bruton in Somerset, Bagley Wood, near Oxford, and the failures at Kirkham, and numerous other localities. In fact, there is scarcely a formation below the chalk, in which researches of this kind have not been made. Amusing instances might be given. A Welsh explorer complained of the want of spirit in the gentry, while he was searching for coal, where he never could find it. To the proverb, "All is not gold that glitters," we would add an equally valuable one—viz., "All

is not coal that looks black," which might again be thus varied—"All that looks black won't burn like coal." Just so, every *man* that looks coally is not a pitman, otherwise our chimney-sweepers might be called colliers. The author would indeed be fortunate, if he had all the money this little book, and these few pages of it, *would* have *saved*.

THE "WINNING" OF THE COAL; OR, HOW TO GET AT IT.

The first thing is to know where the coal lies; the second, how you can get at it. The knowledge of one fact is of no use without the knowledge of the other. A man may perish through a whole winter on the top of a thousand tons of coal, if he cannot reach them, and put them in his coal-scuttle and stove. The word "winning" seems peculiar as applied to coal, and is probably local. One hears of winning a prize, winning a game, or winning a wife—but probably the reader has never before heard of winning a coal-seam. And yet few better or more expressive terms can be used; for as winning always implies doubt of the issue previously, and toil and ingenuity as elements of the success, so is it with coal-winning, which you will allow as we explain the process and its impediments; and perhaps the winning of a coal-seam may include in it the winning of a game, a prize, and—a wife!

Before the publication of our old instructor in geology, "Strata Smith," as he was called, because he was always and to every one talking of strata—before the publication of his large and first geological map of England, in sixteen sheets, no precise information as to the position of coal existed in print. The consequence was, the prevalence of a kind of mysterious craftsmanship amongst mining engineers, which, although it did not include the use of the divining rod, as in the case of metalliferous mines, yet was nearly as secret, and partook much of the nature of mining legerdemain. The public has to thank the geologists for opening this knowledge to any studious and careful inquirer. We have already briefly explained the geological and local position of coal; we therefore proceed to observe, that it is only in some situations and under peculiar circumstances that denuded strata

containing coal present themselves. Hence one chief difficulty met with in exploring a coal-field, arises from the great thickness of the alluvial cover which completely hides the outcrop or outburst of the strata (termed by miners the rock-head); and also completely conceals the fissures, dykes, and dislocations of the strata, which produce such material alterations in the coal-field. This alluvial cover may be compared to the flesh upon the bones in animals. If the flesh be on, as in life, the whole frame presents a superficially smooth appearance, and you would not imagine how many strong, hard, branching, and interlacing bones are under that smooth cover; so with the stony strata—seeing the grass, and the herbage, and the flowers at the surface, all smooth and sloping, you would not infer dislocations, disjointures, and rough strata underneath. The flesh and the green surface alike in either case conceal the internal structure. But if the flesh be removed, the whole structure of the bones, and their situation and connection, are at once discovered. Were the alluvial beds uncovered in the same way, the whole under strata would be distinctly seen, and the effect of every dislocation immediately ascertained. This advantage to the miner would be a great disadvantage to the farmer, who would then have no soil for his seed, and we should have no corn for our granaries, and therefore, literally, we should ask for bread and they would give us a stone. Moreover the mines themselves would be deluged with every storm of rain; whereas at present the alluvial cover affords protection and shelter to the coal-miner, by distributing the water through its permeable soils, and causing it to flow along until it finds the rivers and streams, which are the great natural drains for the moisture on the surface of the earth. This is another of those numerous, and yet generally unknown instances, in which the well-instructed can see how Providence has disposed even the very ground we tread, in the most perfect and orderly manner for man's use and comfort.

BORING FOR EXPERIMENT, WITH ILLUSTRATIONS.

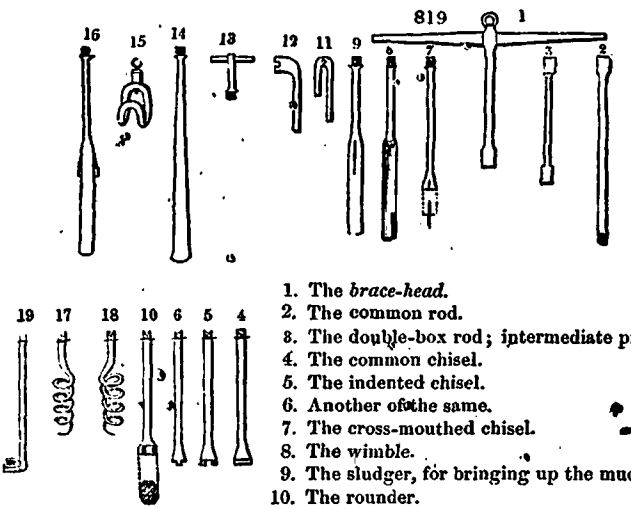
Coal, then, being exposed at the surface in very few instances, some plan must be devised for ascertaining its exact position,

when we know its existence in general, before we go to the great expense of sinking a large shaft. It would be ruinous to sink shafts without a very fair conjecture of the depth and position of the main seams previously. The only mode of arriving at this conjectural information inexpensively is, by boring small though deep holes through the whole strata. Thus you see that in mining affairs, as in other affairs, *boring* precedes *winning*. But to proceed with coal-boring—a certain spot is fixed upon as likely to afford the best indication of the different substances from the surface to any given depth, and the exact thickness of each stratum at a fair place of boring. Thus it can be ascertained whether the strata correspond with the registers of other previous borings, and whether the coal lies at such a depth, and in such seams as will warrant the sinking of a permanent shaft at that spot. The result of boring is the answer which the earth itself gives to the miner's first inquiry, and demands the fullest attention.

It may perhaps be difficult for an ordinary reader to conceive how this boring can be any thing else than a *bore* in all senses. But let him be informed that there are people who take more delight in this process than other people do in cards and balls. Hear only what a thoroughly devoted miner has put into print on the delights of coal-boring. "Of all branches of business," says Williams, "of all the experiments that a man of sensibility can be engaged in, or attend to, there is perhaps none so amusing, so engaging, and delightful, as a successful trial upon the vestigia, or appearances of a seam of coal, or other mineral discoveries. When you are attending the people who are digging down or forward upon the vestige of the coal, and the indications are increasing and still growing better under your eye, the spirit of curiosity and attention is awakened, and all the powers of expectation are elevated in pleasing hopes of success; and when your wishes are at length actually crowned with success, when you have discovered a good coal of sufficient thickness, and that all circumstances are favourable, the heart then triumphs in the accomplishment of its wishes—with solid and satisfactory joy. There is more rational delight, more substantial pleasure and

happiness to be enjoyed in such scenes as this, than in all the celebrated amusements which luxury invents and pursues." And so there undoubtedly is to a curious and geological mind. There is, however, an opposite view. If the pleasures of successful boring are great, equally but oppositely great are the disappointments of failure—no coal, no comfort.

The implements of the borer are represented in the accompanying figures.



1. The *brace-head.*
2. The common rod.
3. The double-box rod; intermediate piece.
4. The common chisel.
5. The indented chisel.
6. Another of the same.
7. The cross-mouthed chisel.
8. The wimble.
9. The sludger, for bringing up the mud.
10. The rounder.
11. The key for supporting the train of rods at the bore-mouth.
12. The key for screwing together and asunder the rods.
13. The topit, or top-piece.
14. The beché, for catching the rod when it breaks in the bore.
15. The runner, for taking hold of the topit.
16. The tongued chisel.
17. The right-handed worm screw.
18. The left-handed do.
19. The finger-grip or catch.

The principal instruments in use in all districts are:—1. Bore rods of best iron, one inch square and of different lengths, each rod having a "male screw" at one end, and a "female screw" at the other. 2. Chisels fitted with screws, well tempered with steel, with a face of 2½ inches, and generally 18 inches in

length. 3. A wimble, viz., a hollow iron instrument like an auger, whose cavity is from 6 to 10 inches in length, with an opening up one side, with partial overlap, the better to receive and hold the chopped strata. 4. Exactly over the spot where the boring has to be made, a large frame or triangle, 20 or 30 feet high, is erected.

In boring the lowermost rod is the chisel, which continually operates on the rock or stratum. The uppermost rod terminates in a stout ring, through which passes a cross-piece, held by two men in working, and which is also suspended to a springing pole by a chain. One or more rods being pushed into the ground, two men on a wooden stage take hold of a cross stave at the end of the springing-pole, and work it steadily up and down, while two men below, by means of the cross-piece, at the same time heave and depress the suspended rods, walking slowly round the hole. By these combined operations of chopping and scooping, they make slow way through whatever substance may be in contact with the steel chisel of the lowest rod. When the boring becomes obstructed by matter removed, or when the stratum is to be examined, the rods are drawn out by the tackle at the top of the triangle, and replaced by others. It is remarkable how such simple apparatus will get through the hardest rocks. If the reader ever visits the Black Rock at Clifton, near Bristol, he may see a similar process performed on a smaller scale by two men, who are always at work in boring holes in the limestone for blasting by gunpowder. That limestone is almost as hard as any stone, yet by patient hammering upon an iron chisel, or tamping iron, they can make certain and regular progress. The difference in the Clifton quarry is, that the men force down the rod by a heavy hammer very powerfully wielded; whereas in experimental coal-boring the rods armed with the chisel are merely raised a few inches, and then allowed to fall by their own weight. When the hole is too deep, the added rods become too heavy to be conveniently lifted by manual labour, and a brake or lever is employed, or a horse-gin or steam-engine; for in deep borings the work becomes both laborious and critical. Therefore, while the charge for boring for the first five fathoms is only 7*s.* per

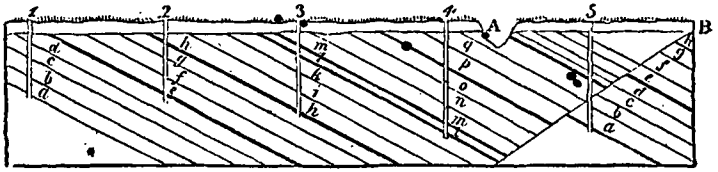
fathom; it ascends by scale to 49*s.* per fathom for the seventh five fathoms, with extra charges for boring basalt and other hard strata.

Practised borers can ascertain with the greatest nicety the nature and thickness of the strata bored through, and can form a very correct opinion as to the nature of the "feeders" or springs of water met with in the process. The task is important; for an erroneous account of the strata might lead to large expenditure and irretrievable disappointment. Various improvements have been suggested as to the mode of conducting borings, and one has been patented. In the North, borings have frequently been accomplished to the depth of 130 fathoms (*i. e.*, 780 feet), when so great a depth is contemplated, a small shaft is generally sunk to expedite the process. Holes can be bored upwards with ease, as the hole clears itself of matter. Prudent men do not satisfy themselves with one boring, but by executing a succession of borings to some well-ascertained seam, a fair opinion may be formed of the direction and amount of the dip and rise of the coal, as also of the nature of the roof. Indeed it is only by multiplied borings that it can be inferred that the principal seams of coal are parallel to each other, without being upthrown or downcast by faults. Horizontal borings are very useful when miners are suspicious of their approach to old wastes and workings of other mines, where water or destructive gas may be accumulated. This kind of work is carried on by *drifts*.

The omission of borings, by way of exploration in mining progress, has often led to most disastrous results; for although, in many cases, the coal strata are so open as to indicate the vicinity of a "drowned waste" long before the workings are brought into contact with it; yet not seldom does the reverse happen, in consequence of both coal and stone being so completely water tight, that they exhibit no symptom of water till the communication actually takes place. Therefore in collieries lying to the dip of drowned wastes of uncertain form and extent, a good system of exploratory boring is essential to the safety of the mine. For when once the existence of a waste is ascertained, the water accumulated in it can be let off in small quantities to the pumping

engines, and an opportunity taken to drain it, and thus to procure the coal which had been previously left as a barrier of safety. So then boring downwards and upwards and straight before you, are necessary to and in coal-working.

Let us take an illustration of a district of coal country in which a regular survey has proved the existence and general distribution of coal strata, with a dip to the south, as shown in the figure. The darker lines represent coal-seams, and the fainter lines their associated strata.



A convenient spot is fixed upon in the northern part of the district, so that the successive bores may advance in the line of the dip. The first bore, therefore, may be made at No. 1, to the depth of sixty yards. In the progress of this perforation, many diverse strata will be passed through, as we see in the sections of the strata. Each of these, with its quality and thickness, is noted in the journal, and specimens are preserved. This bore penetrates the strata *d*, *c*, *b*, *a*, without touching any coal. Suppose that the dip of the strata is one yard in ten, the question is, at what distance from bore No. 1, in a south direction, will a second bore of sixty yards strike the first stratum *d* of the preceeding series? A known rule of calculation gives us the distance of 600 yards. Hence the bores marked 1, 2, 3, 4, and 5, are successively distributed as in the figure, the spot where the first is commenced being regarded as the point of level to which the summits of all the succeeding bores are referred.

In No. 2, coal is seen to occur near the surface, and another seam (distinguished by the darker line,) is entered at the bottom of the bore. The bore, 1 and 2 have proved the beds to the depth of sixty yards each, and 120 yards together.

In No. 3 bore, we pass through two coal seams near the sur-

face, and another at the bottom of the bore, after reaching to nearly its depth of sixty yards. It will now touch the stratum *h*, which is the upper stratum of bore No. 2; but since a seam of coal was detected in No. 2, under stratum *h*, the proof is confirmed by running the borer down through that coal. The field has now been probed to the depth of 180 yards in all. The fourth bore is next proceeded with, until the two coal seams which met in No. 3 have been reached, when in all a depth of 240 yards has been explored. Hence the bore No. 4, could not reach the lower stratum *a*, unless it were sunk for 240 yards.

The fifth bore being sunk in like manner, a new coal seam occurs within a few yards of the surface; but, after sinking to the depth at which the coal at the top of the fourth bore was found (*i. e*, between *p* and *o*) an entirely different order of strata occurs, as shown in the diagram. This will probably occasion perplexity, and then experienced mining engineers must be consulted. Where the coal-field is intersected with many slips, it may happen that the most experienced miners will be bewildered.

SINKING THE SHAFTS—EXPENSES OF SHAFTS.

Having ascertained the existence and workable condition of coal by boring, and reasoning from its results, as above described, the next and most important business is that of sinking the shaft, or great opening to the mine.

What a door is to a house, or rather a door and a passage, that a shaft is to a coal-pit; with, however, this great difference, that you commonly build your house first, and put in your door last; while in the mine, you must open the shaft and fit up all its concomitant machinery before you can get into the interior.

I shall shortly speak of the great difficulties frequently encountered in sinking shafts, arising from feeders of water, quick-sands, &c. The difficulties very greatly increase the expenditure incurred in sinking shafts. From the large sums mentioned in evidence to Parliamentary committees, as being expended upon certain shafts in the north, an exaggerated notion has prevailed on the subject, insomuch that the exception has been supposed

to be nearly the rule. The partial evidence, or rather erroneous impressions conveyed by it, seem to have arisen from a fear that the legislature might recommend or enforce the increase of shafts in large mines, for the purpose of improved ventilation. By the evidence given before a House of Commons committee, in 1835, an impression was conveyed, which is manifested in the following questions put by the committee, or one of their number. When Mr. Taylor recommended more numerous shafts for ventilation, he was asked, "If he was aware that the cost of sinking a single shaft would frequently, in the counties of Durham and Northumberland, exceed £100,000?" Again, when Mr. Garforth from Lancashire tells them, that though they have there feeders of water and quicksands to contend with, yet they can sink a shaft of eleven feet diameter, and 250 yards deep, and properly walled or lined with brick, for a sum of from £1200 to £1500—or a little more than £5 per yard, the committee astonished him by stating, that "in many districts of the north a shaft of the same diameter and the same depth would cost £50,000." Had the committee instituted proper inquiries, they would have found these to be the extreme cases.

I suppose the most expensive of all single shafts was that of the Monkwearmouth pit, near Sunderland, in sinking which the Messrs. Pemberton expended upwards of £80,000. A similar most costly sinking was that at Datton-le-Dale, in Durham, undertaken by the South Hetton company; but there they had to encounter an almost impassable quicksand, which required many months' labour, and a steam power of no less than 1274 horses to triumph over it. Such a power was never before employed at a colliery, and therefore such a case is a solitary exception. Yet, even in this case, so alive were the enterprising owners to the importance of more than one shaft, or two shafts, that, though they have two fourteen feet pits within forty-five yards of each other, they have expended immense labour and cost to add another of sixteen feet diameter, within a fifty-five yards' range of the other shafts.

It has been computed, by a committee of private gentlemen at South Shields, that shafts can be sunk, even in the difficult coal-dis-

trict of the north, on a regular average of at least seventy to eighty per cent. under the prices named by the Commons' Committee. For example, a single pit eleven feet diameter, and 300 yards depth, would not ordinarily cost more than from £2000 to £2500; nor would a 14 feet pit, of 300 yards depth, require a greater sum than from £2500 to £3000. For reducing feeders of water, as subsequently described, a large pumping-engine of from 200 to 300 horse-power would be required; so that, if the requisite steam-power were 250 horses, there would be an additional expense of about £5500 for an engine with masonry, &c. This engine, however, would serve as much for the mine as the shaft. Accurate data have shown the expense of some ventilating and winding shafts, of 8 feet diameter and 200 yards depth, not much to exceed £3 per yard for sinking and walling; and one eleven feet engine-pit cost less than £5 per yard. On the same system, at least two shafts may be placed under the operations of one pumping-engine. After one shaft is sunk, or while it is in progress, unless there be some feeder of water, or hidden obstacle, a second shaft is put down much more easily, as the first, if placed within a reasonable distance, serves to drain and keep the other dry.

Now, these matters are very pressing at the commencement of operations, for that is the only time when more than one shaft can be sunk without inconvenience. The general reader scarcely knows of how great importance this doubling of shafts, or trebling them, is in the safety and comfort of mining operations.

Out of the ponderous folios of blue books, containing the most detailed questions and answers of committees and witnesses on mining accidents, and out of the more humble and restricted publications of remonstrants against the owners and managers of mines, you may gather one prevailing cry and demand, and that is in brief—*more shafts and more air.* This demand is continually made by the miners themselves. The objection of the owners and managers is *expense.* This objection is answered as above.

There can be no doubt that two separate shafts, instead of one *bratticed* or divided shaft, should be sunk in every large colliery.

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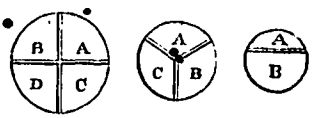
The testimonies of numerous eminent authorities might be adduced to this effect. Mr. George Stephenson said, "I think the ventilation of coal-mines would be much more certain, if two pits were sunk instead of one. The system in the neighbourhood of Newcastle has been to sink one large shaft, and to divide it into two, three, or four divisions, there being only five inches of wood between the one and the other. A much better, and in the end much cheaper, ventilation would be carried on, by having two pits instead of one." He then adds that he has adopted this plan in many of his own new collieries in the Midland districts.

The mode of dividing two shafts in the northern coal-pits may be seen from the accompanying figures.



In order to illustrate the sinking of shafts on a general plan, in the most approved form in the Newcastle district, let us assume the depth of an intended winning to be one hundred fathoms, or six hundred feet, with a pair of shafts, each ten or twelve feet in diameter, prepared for pumping apparatus, and requiring walling and "tubbing," and all the appendages for efficient sinking, with the difficulties of abundant springs of water. First, there must be a great variety of implements handed to the sinkers, who are not regular colliers, but a special class of workmen. To describe these implements, such as jack rolls, whim-gins, prickers, beaters, scrapers, and tomahawks, would frighten the reader. Therefore, assume that the sinkers have all these implements—enough at any time to sink them in the Tyne or Wear. Before the shaft can be sunk, there must be a regular establishment on the ground, of wrights' and smiths' shops, cottage houses, offices, crabs, shearlegs, winding and pumping engines, ponds, fire-lamps, sinkers' lodge, heap-stead, and sundry other accommodations according to circumstances. No trifle, these things *before* we begin.

The situation, form, and size of the shaft having been determined, operations are commenced by digging out the soil to a proper extent, and then erecting a windlass, an ancient mining

apparatus. After the sinking has proceeded some yards, or a few fathoms, it will probably become necessary to commence operations for securing the whole interior of the shaft, except in very solid parts, by a lining of brick. This cylindrical wall is raised upon a circular framework of wood, called a *crib*, and which is itself made to rest, where practicable, upon a rocky or other solid ledge, or on keys driven into the sides of the shaft. The sinking is then resumed, and in due course another circuit, or cylinder of cribbing, is laid in, and a section of walling carried up until it joins the lower part of the preceding fabric. These operations and precautions are repeated at intervals, more or less frequent, according to the nature of the strata; the rocky portions not always requiring such support. Travellers by our railways may see something analogous to this in the deep cuttings, as at Blisworth, on the North-Western line, where the sides of the cuttings are partly built up with stones to support the whole, a process which engineers call "underpinning." In order to secure the exact perpendicularity of the shaft, and its regularity of circumference, a plumb line is suspended from top to bottom, and the distance to the sides of the shaft is measured by a rod. This is easy in the circular or square shaft but difficult in the oval; the measurement having then to be made from three centres. The sinkers are proud of a good oval shaft, saying, "There, maister, she's as right as a hen's egg."

WATER IN SHAFT-SINKING—LINING, TUBBING, &c.

The arch-enemy of coal-winning is *water*, and there are some mines from which a much larger quantity of water is raised than of coal. One chief use of the large assemblages of steam-power in several of the northern collieries is for pumping out water.

The occupation assigned, according to ancient mythology, to the fifty truculent daughters of Danaüs, was scarcely more interminable than that of many of the pumping engines at collieries. In the sinkings at the Great Hetton colliery, in the county of Durham, there were three principal springs, or *feeders*, met with. The term *feeders* is very expressive, and intimates that the out-

flow of the water is constantly fed from some unseen source. Of these three feeders, the first issued 2000 gallons of water per minute; the second, 1000 gallons per minute; and the third, 1600 gallons per minute. Hebburn colliery, commenced in 1792, is said to have supplied upwards of 3000 gallons per minute. I used to think these quantities exaggerated till I stood by the side of the enormous steam-engines, and seeing the work they were doing in pumping, I could easily conceive of the resources of the feeders—and most voracious feeders they must be. It is generally supposed that these waters are originally derived from the surface, that is, from rains and floods percolating through the alluvium or superficial beds of earth and soil; and this supposition is confirmed by the fact that at great depths the feeders are much less abundant, and far less formidable, than at lesser depths. The main body of water in the north, seems to flow forth at not more than forty or fifty fathoms from the surface. It cannot, however, be from direct percolation of rain that much of the water penetrates to the lower depths; for although the "posts," or sandstones, are porous, and therefore admit the passage of water; yet the "shales," found so abundantly at the lower depths, are compact, and impervious to water. We must suppose, therefore, that the surface waters find their way indirectly, and by very circuitous percolation, through partings of the shale, or through fissures and cracks, down to these lower depths, and there accumulate in the course of centuries in enormous quantities; or there may be springs fed by unknown and unsuspected tributaries. The question is difficult of reply.

But if the fissures and cavities in the strata do not become reservoirs of water, they are receptacles for gases of a dangerous and inflammable character; so that, if the strokes of the coal-hewer's pickaxe should tap one of these cavities, although it may not evoke the "spirits of the vasty deep" of waters, it may give demons of foul air a chance of escape from their rocky prisons; and the poor pitman (like the unlucky fishermen in the Arabian Nights, who fished up and let out the sealed genius of the casket) may suffer death for his unintentional liberality.

The water of coal-pits is commonly much purer than might be imagined,* although it usually holds some foreign ingredients in solution, such as sulphate of iron. It is, however, a curious fact, that some of these waters are salt (some say all the deep-springing waters are always salt), and, still more curious, that they are sometimes salter than sea-water. This is sensibly demonstrated, not only by the taste, but by the smarting sensation occcasioned by the falling of some of this water upon any part of the body where the skin is abraded. At one pit, not long since, a feeder was pumped the water of which was estimated to be three times salter than the sea. Indeed the abundant supply of these brine springs at three contiguous places, suggested the erection of salt-works on the spot. The source of their salineity is a curious speculation.

It has happened more than once in sinking shafts, where all had proceeded favourably for many fathoms, that on coming to the next fathom, the privacy of some too abundant feeder has been intruded upon; and that to complete the safe passage through that one enemy's domain, a pumping-engine has been necessary, which, upon advancing to the next fathom, could be dispensed with. Thus all is uncertain in sinking, and every appliance must be provided. In place of the brick walling of shafts, a cast-iron casing or "tubbing" has been of late years successfully introduced. This iron tubbing consists of short cylindrical portions, the cylinder (as I saw it in course of fixture in a shaft at Hebburn colliery for thirty fathoms), being formed of ten segments, each of which segments might weigh about four and a half cwt., and was of solid iron, with the exception of a hole for the purpose of raising it.

Of the methods of lining the shaft and stopping back the water, it may be said there are three now in use. 1. Plank tubbing, and curb solid tubbing.—Plank tubbing was used in

* Analysis of water found in the Bensham seam, Wallsend colliery.
The gallon contains:—

Muriate of lime	2094·39 grains.
Soda	455·49 grains.
Magnesia, oxide of iron, &c.	traces.

sinking one of the shafts of Hebburn and other deep collieries about 1790. The planking usually consisted of two and a half or three inch deals, applied in lengths of eight or ten feet, being first planed, and their joints well bevelled to the circle of the shaft. After which they were fastened to the curbs by iron spikes. This kind of tubbing, when well executed, will bear a pressure of 100 lbs. to the square inch, and endure for many years where the water is tolerably fresh; but in collieries where the water corrodes the iron, the most ruinous effects follow on the use of planked tubbing, since it is next to impossible to reach the spike holes after the shafts are fitted up with divisions and pumps, and the leakage of the water under pressure, however small the leakage and its space to the view, becomes intolerable. This difficulty led to curb or solid tubbing of wood, which neither required wood planks nor spikes of iron, and therefore, when once of sufficient strength and tightly fitted, stopped all leakage, and at the same time presented a smooth circular surface for coal-drawing, and transit of men. Detached pieces of tubbing can be inserted in this at any time. It has every advantage for ordinary mines, and will often sustain a pressure of forty fathoms, or twenty atmospheres.

2. Stone tubbing.—This is merely walling; but the foundation is made water-tight, by means of grooves cut in the stone, and by joints and backings of cement. This will answer for light pressures, but is too precarious for important works; therefore wood or iron are commonly employed in all large collieries.

3. Metal or iron tubbing.—This is the kind of tubbing now almost universally employed; and the only drawback from its use is its liability to be corroded by saline waters, especially in hot smoky shafts, where the metal is found, in the course of time, to carbonize to such a degree that it may even be cut with an ordinary pocket knife. In such cases the tubbing will sometimes give way, and let down the waters behind, and bring ruin and disaster with it. I have not heard that any remedy against this mischance has been discovered. It can only happen rarely, and may by careful inspection be foreseen. I have already described the segments of which this tubbing is composed. They vary in

size and thickness according to the expected pressure, but their length may be stated as being in general at three or four feet, and their thickness three-eighths of an inch to an inch. The following table of tubbing, applied on the Newcastle system at Prestongrange colliery, in East Lothian, Scotland, will afford an idea of the system in measurements and weights :—

TABLE OF DIFFERENT TUBS, AND THEIR EFFECTS IN A COAL-WINNING.

Weight per Segment.	Weight per Fathom.	Length.	Quantity of Water stopped per Minute.	Bottom of Tub, depth from Surface.
Cwt. qr. lb.	Cwt.	Fathoms.	Gallons.	Fathoms.
1st Tub... 2 0 0	48	8	200	9
2nd Tub... 2 2 0	60	6½	300	28
3rd Tub... 2 3 0	66	4	300	36
4th Tub... 3 2 0	80	4½	350	44
		23	1150	

At Hartop winning, county of Durham, an unusual quantity of metal tubbing was inserted, one length under another. No sooner was the water stopped than, upon sinking underneath, it followed down the chinks of the strata, requiring a succession of tubs till eighty fathoms were completed, which was surmounted by eleven fathoms of walling. Assuming that those waters were derived from the surface, then the lower tubbing sustained fifteen atmospheres, or a pressure of 225 lbs. per square inch!

DIFFICULT AND COSTLY WINNINGS.

A few notices of some of the more difficult winnings in the northern district may interest the reader. Hebburn colliery may be easily reached by any visiter to Newcastle. Coals appear to have been worked here at a very early period; but the present colliery was commenced in 1792. The winning was considered one of the most arduous and difficult that had ever been attempted up to that period. The quantity of water to be drained amounted

to upwards of 3000 gallons per minute, and this had to be stopped back by wooden plank tubbing, as it was then but imperfectly known. A series of cribs, each six inches square, were placed at intervals around the interior of the shaft. To these were spiked a perpendicular lining of two-inch planks, upon which was another series of leading cribs, supporting a lining of one and a half inch deals. By this arrangement the great body of water was shut back, and the pumping-engines were enabled to command the remainder. For many years this tubbing continued tolerably effective; but the corrosive qualities of the water gradually destroyed the iron spikes, and caused so great a leakage, that the plank tubbing was being replaced with the more modern and effective invention of cast-iron segments, as I have just described them.

At the last pit that was sunk (called the C. pit), the solid wooden tubbing was used, consisting of solid cribs placed one upon another, all the joints being lined with thin deal, and wedged water-tight. Thus three varieties of tubbing are practically illustrated in this colliery. The strata at Hebburn are identical with those of Jarrow colliery, about a mile from it. The Bensham seam is about forty-five fathoms below the High Main seam. The Heworth band also prevails in this colliery, where its thickness in the line of Hebburn Hall, amounts to a prevention of working the seam as a whole. Although, somewhat anticipating my subsequent course, I will here notice the *workings* of this colliery.

The difficulties to which the working of this colliery has been exposed, were singularly great and various. In the first place, the cost and risk of it were considered enormous at that period. The quantity also of inflammable gases evolved during many years of inexperienced practice, caused innumerable, and some most disastrous explosions. So hardened were the workmen by familiarity, that they frequently saw without alarm, streams of blue flame emanating from the furnace at the bottom of the shaft, kindled for purposes of ventilation. At that time, the only light obtained in the inner parts of the mine was from steel mills, of which 100 were in daily use. This steel mill was a small machine

with two cog-wheels and one plain wheel, of some six inches in diameter. A piece of flint was applied against the steel periphery of the wheel, and the machine being put in motion by a small winch handle, a stream of sparks was elicited, which gave light without flame, and thus secured the miners' safety.

The subject of ventilation, too, was then ill understood, and the ventilating current of air, according to custom at that time, was carried *entire* through all the ramifications of the mine, being compelled to run a course of about thirty miles between its entry and its exit. Further, about the year 1810, a general *creep* overtook the whole colliery, which suspended all coal-working for a considerable time. This creep was a kind of subsidence of the strata, from immense superincumbent pressure in some parts, which naturally produced a corresponding rise in the other parts; and thus there was a tendency in the roof and the floor to approximate. During the discharge of inflammable gases, which was very greatly increased in consequence of the creep, no ventilating furnaces were safe, and therefore the expedient of an air-pump was tried. It was five feet square, was wrought by one of the steam-engines, and produced a considerable current; but, from the nature of the application, was of course liable to irregularity and stoppage:—so great and accumulated were the difficulties to be contended with in the winning and working of this colliery. It is an interesting one on all these accounts, and also because it is said to have been the first colliery visited by Sir Humphrey Davy, during a sojourn at Hebburn Hall, the seat of Mr. C. Ellison. It was from bottles of gas taken from one of the "blowers" of the B pit dyke at Hebburn, that this celebrated chemist made his experiments and analyses. They tell us, also, that the first lamps were sent down here to be tried. The colliery is now wrought by Messrs. Easton and Co., and the coal is called in the market, the "Hebburn Main."

WINNING OF GOSFORTH COLLIERY.

Gosforth colliery lies about three miles north from Newcastle, and on the west bank of a romantic "dean," or little valley, through which the Ouse Burn winds its way to the Tyne. The

sinking was commenced in 1825, and the coal was won on Saturday, January 31, 1829. Great expense was incurred in this undertaking, from the geological phenomenon before alluded to, namely, the intersection of the great ninety-fathom dyke.

The High Main coal was reached at twenty-five fathoms below the surface; but near its first appearances the seam was thrown down in an inclined direction by the dyke, to the depth of 1100 or 1200 feet. The quality of the coal was so deteriorated by the proximity of the dyke, that it became necessary to sink the shaft perpendicularly to the depth of 181 fathoms, in order to come at the level of the lower range of the seam of coal. In this work many of the succeeding seams of coal were passed through, and found to be all more or less shattered by the dyke, and singularly placed at a higher level than the High Main, which in a geological point of view they underlie. On reaching the necessary depth a horizontal drift, 700 yards long, was worked through the face of the dyke to the seam of coal a little above its junction with the dyke. A great part of the excavation was made through solid rock.

A GRAND BALL IN A COAL-PIT.

So remarkable a winning deserved a celebration of its attainment. Some persons would have had the workmen out in a field, and made them spectacles of inebriety to the open eye of day. But the proprietors adopted a more suitable plan, which so commended itself to a friend of the author's, that she has begged him to get her a ticket of *descent*, should such a rejoicing ever again take place. The plan was that of a *grand subterranean ball*, at the very place of triumph! The *ball-room* was situated at a depth of nearly 1100 feet below the surface of the earth, and was in the shape of the letter L, the width being 15 feet, the base 22 feet, and the perpendicular height 48 feet. Seats were placed on the sides of the said ball-room, the floor was dried and flagged, and the whole place was brilliantly illuminated with lamps and candles. The company began to assemble, and descend in appropriate dresses, about half-past nine in the morning, and continued to arrive till one in the afternoon.

The men engaged in the work, their wives and daughters, and sweethearts; several neighbours with their wives, the proprietors and agents with their ladies, and sundry friends of both sexes who had courage to avail themselves of the privilege;—all these gradually found their way to the bottom of the shaft. Immediately on their arrival there, they proceeded to the extremity of the drift, to the *face* of the coal (coal never has a white *face*, though it sometimes has a *clean* face in mining language); at the face each person hewed a piece of coal as a memento of the ball, and then returned to the ball-room. As soon as a sufficient number of guests had assembled, dancing commenced, and was continued without intermission till three o'clock in the afternoon. No distinction was made among the guests, and born and bred ladies joined in a general dance with born and bred pitmen's daughters. All now returned in safety, and in nice clean and well-lined baskets, to the upper regions, delighted with the amusements in which they had been engaged. A local band of miners' musicians was in attendance, and the pit was filled with music and merriment. The genii of the caverns were startled, and the young dandified pitmen never looked so happy, so clean, and so gay. Refreshments were not forgotten, and cold punch, malt liquor, and biscuits of all kinds, were dispensed in abundance. It was estimated that between 200 and 300 persons were present, and that nearly one half of them were *females!* It must be remembered that the pit was clean, prepared, and had not been worked; so that no smoke and dust exuded from its mouth, and every facility was given for a comfortable, slow, and safe descent.

Another difficult sinking was that of the Eppleton Jane pit, as narrated by Mr. Buddle, of whose account the following is an abstract. After passing through four different strata, consisting of the alluvial cover, sand, and gravel, limestone, and yellow sand, water was reached, which produced 360 gallons an hour. In the next eight yards seven other strata occurred, and the influx of water now increased to about 4200 gallons per hour. At sixteen yards ten inches below the surface, the first coal-measure was met with. The whole of the water was stopped by *cribbing*, as I have

already described the process. The progress of the work from its commencement to its termination was as follows, in brief:—12 strata to the first coal-measure; 10 strata to the second; 6 strata to the third; 5 strata to the fourth; 6 strata to the fifth; 7 strata to the sixth; 7 strata to the seventh; 4 strata to the eighth; 5 strata to the ninth, or "*three quarter coal-seam*," with about twenty inches of coarse top coal and coarse bottom coal; 6 strata to the tenth coal-measure; 2 strata to the eleventh; 3 strata to the twelfth; 10 strata to the thirteenth, coal—"High Main"—at a depth of 296 yards from the surface. So the sinking proceeded, but we do not give the minute detail, to the "*Hutton coal-seam*"—one of the very best coals in the market. The depth from the mouth of the pit to the "thill" of this seam, was 348 yards 11 feet 2 inches. Excavations were made some 6 yards 5 feet deep, making the total depth of the pit 356 yards, 2 feet 3 inches, in the course of passing which no less than 132 strata, including the various coal-measures, were cut through. This abridged account will give the reader nearly as good an idea as a coloured section of the whole sinking and strata. We must observe, that in all this series of strata only four principal seams of coal were reached; first, the Three-quarter seam; next, the High Main coal; thirdly, the Low Main coal, which here contains five feet six inches of good coal, and lastly the Hetton coal-seam. It will thus be understood how very small a proportion the thickness of the seams of valuable coal bears to the whole strata sunk through.

One of the most laborious and expensive winnings was that of the South Hetton collieries, seven miles east of Durham, before alluded to. The quicksands here, and the irruptions of water, seem to have been very formidable, perhaps the most so of any known. I spent one half day in picking up scraps of information about this winning on the spot. I filled my note-papers from the kind answers of one and another; and I have given, in pages 117 and 118, some details of the steam-power employed there.

The winning of the Great Hetton pits was also very costly. In the first sinking the principal feeders of water supplied 2000 gallons per minute; in the second, 1000 gallons, and in the

third, 1600 gallons per minute. The waters were mostly fresh, and only sometimes impregnated with iron.

THE WINNING AT PEMBERTONS' SHAFT, NEAR SUNDERLAND.

Probably the most celebrated winning in the whole northern coal-field was that of Pembertons' pit, at Monkwearmouth, near Sunderland. The upper part of this celebrated shaft is sunk through the lower magnesian limestone strata, which overlap the south-eastern district of the great Newcastle coal-field, and which, including a stratum of freestone sand at the bottom of the limestone, extended at Monkwearmouth to the thickness of 330 feet, and discharged, towards the bottom of the strata, the prodigious quantity of 3000 gallons of water per minute! For the lifting of this water into an off-take drift, a double acting steam-engine, with a power of from 180 to 200 horses, was found indispensable. The first unequivocal stratum of the coal-formation, viz., a bed of coal one and a half inch thick, was not reached till August, 1851, at about 344 feet below the surface. After this the tremendous influx of water, which had so long impeded the sinking operations, was "stopped back" by the metal tubbing, which extended from the above bed of coal to within twenty-six yards of the surface. The sinking now proceeded with spirit. Still no valuable or available coal was reached, although the shaft had now passed considerably above 600 feet into the coal-measures, and this was much deeper than had been hitherto found requisite for reaching some of the known seams. It therefore became evident that the miners were in unknown ground. A new "feeder" of water, too, was encountered at the great depth of 1000 feet, requiring fresh pumps, and an additional outlay of money. For to raise the water it became first necessary to "raise the wind," and a "feeder" of water is generally any thing but a feeder of the operatives.

The prospects of the owners now became as black as the coal they did *not* get. Many of the coal-viewers pronounced the winning hopeless. Coal-viewing, however, had as yet been limited to some 200 or 220 fathoms, and the enterprise of the

Messrs. Pemberton, the operators and capitalists, was not to be bounded by such ordinary depths. They correctly considered that the thickness of the coal-formation might be vastly greater where protected by the superincumbent limestone (magnesian), than where exposed to those denudations which, in the neighbourhood of the "rise" collieries, had probably swept away the strata through which their own shaft had hitherto been sunk. They thought, therefore, that they were justified in anticipating the larger and known seams at greater depths; and that in case these larger seams had (as was estimated) been split into smaller strata, the same causes which in other places had produced their subdivision, might at Monkwearmouth have effected their junction. Therefore they continued their sinking, and in October 1839, it became in truth a "winning," for they reached a seam of coal of considerable value at the depth of 1578 feet below the surface! Presuming that this newly-discovered seam was identical with the Bensham seam of the Tyne (or the Maudlin seam of the Wear), they rapidly deepened their shaft in anticipation of reaching the Hutton seam of coal, one of the most valuable of all, which they considered would be found at a depth approaching 300 fathoms (1800 feet) below the surface. This winning is supposed to have cost nearly £100,000.

Another successful attempt to win the coal has recently been made near Pemberton's pit, at a less expense.

STEAM-POWER IN COLLIERIES.

Steam-engines are employed in collieries for two principal purposes—pumping and winding. Let us speak of each separately.

1. As to PUMPING.—The concentration of steam-power applied to pumping water out of shafts and pits, is at some places enormous. Of course the amount of power requisite varies with the condition of the strata, the shafts, and the coal. The amount of power employed at the new winning of the South Hetton Company, seven miles east of Durham, is affirmed to be about the largest existing. The diameter of the cylinder of the pump-

ing engines is 84 inches. They are condensing and double engines, and are amongst the largest and most powerful ever erected.

During the progress of the attempted winning of a pit at Haswell, in county Durham, through the sand beneath the magnesian limestone, the engine-power erected pumped feeders to the amount of 26,700 tons per day! At Friar's Goose colliery, near Gateshead, Newcastle, the feeders require three columns of pumps, each sixteen and a quarter inches in diameter, raising upwards of 1000 gallons per minute, or above 6000 tons per diem; whilst the weight of coals drawn out of the mine does not exceed 300 tons per diem, and is often as low as 250 tons; so that in this case the water pumped exceeds the coals extracted some twenty to twenty-four times. Thus, too, we see that it is not merely during the sinking of shafts, but also often during the working existence of the mines, that pumping-power must be employed. Upon the pulsations and vibrations of those ever-beating engines, which you can hear thumping and bumping all the night long, if you sleep near them, or rather lie awake through them—depend the dryness of the mine and the security of the miners. A peculiar noise those engines make at night. I sometimes fancied, as I lay awake near one of them, that there must be some mysterious meaning in the sounds; first, a heavy plunge down, bump and thump, then a short silence, then a kind of long-drawn sigh, such only as a steam-engine could draw, and then a rush of waters, enough to make you dream of drowning. Then, in another moment, again bump, thump, sigh, cry, fuss, and rush, and all this without intermission! How silently in former ages all this water had found its way, perhaps drop by drop, into the stony reservoirs! How silently it had lain there, under solid strata, no one suspecting its existence! But now at length, man must trouble the peaceful waters—must rudely unseal their rocky caskets, and, lo! he shall have no more peace for them—no more quiet shall there be in that vicinity. The fountains of the deep in the hollow places of the earth have been broken up by rude hands, and they shall now pour forth unceasingly thousand gallons after thousand gallons, and these, too, minute by minute

—torrent after torrent—rush, rush, rush! Ah, foolish man! what hast thou done, evoking a Spirit of the floods thou canst not lay? Hear him tearing, tumbling, rushing, and rolling in upon you! What will you do? "What?" says the engineer calmly, "why, put up a pumping-engine and pump, to be sure, and then the pit will be as dry as need be." Truly man is as wonderful in his invention as in his daring. He has invented the steam-engine, applied it, with all improvements, to pumping; and there, down that very pit, three or four hundred persons will be found to-morrow, who will in no instance perhaps think of the floods upon floods that would otherwise inundate them!

Such were my thoughts as I slept one night near the old Percy Main pumping-engine, a short distance from Shields. At the Percy Main pits, which produce that valuable coal, known in the coal-market by the name of Bewicke and Crastor's—at these pits, of the 586 steam horse power in operation for various purposes, 440 horse power are at work for pumping.* One of these engines rates at 250 horse-power; and engines of 200 horse-power are not unusual for pumping water. At the Eppleton Jane pit of the great Hetton Coal Company, I saw a pumping-engine of 250 horse power at work. At the new winnings, too, at Seaton Delaval, higher up in Northumberland, were two or three very powerful engines of beautiful workmanship, which, as far as water was concerned, I thought were not likely to be "out of work" for some considerable time to come. The pumping-engine at the B pit of Hebburn colliery was erected by Messrs Bolton and Watt, and was considered, at the time of its erection, to be the most powerful engine in the north of England,

* Analysis of total steam-power in use at the entire Percy Main collieries:—

A	250	horse power pumping-engine (condensing)	Howden pit.
A	120	" " " "	"
A	70	" " " "	Percy pit.
A	50	" winding-engine "	"
A	40	" " " "	"
A	30	" " " (high pressure)	Flatworth pit.
A	10	" for drawing waggons "	"
A	16	" for a saw-mill "	

Total 586 horses power.

raising the water from a depth of 130 fathoms, or 780 feet. The pumping-engine at Friar's Goose colliery was at one time the largest single pumping-engine on the Tyne, being 180 horse-power. It was erected about 20 years ago. The cylinder is 6 feet in diameter, in which the stroke is 9 feet, and in the pit 7 feet 2 inches. At each stroke about 195 gallons of water are delivered on the surface, and as the average is 6 strokes per minute, 1170 gallons are delivered per minute, or 1,444,800 gallons per day. The depth of this shaft is 55 fathoms, and there are 3 sets of pumps each of 16½ inches diameter. At South Hetton colliery there is a pumping-engine of 300 horse-power. This engine is the most powerful one in the district, and is contained in a noble engine-house of massive stone, including three galleries, which surround the interior. From these galleries the parts and stately action of the entire engine may be viewed. Its regular action at the recurring periods is most admirable, and I stayed nearly half an hour looking at it, and examining its parts.

2. As to WINDING or DRAWING Steam-Engines, these are employed for raising the coals themselves, and also serve for lowering or lifting the men and boys, and for drawing purposes in general. These are of course separate from the pumping-engines, which have quite enough work of their own to do. The largest amount of drawing steam-power I found was at the collieries of the Great Hetton Coal Company, where there are eight shafts and eight winding-engines, four of which are each of 100 horse-power. In the Hetton pit there is a steam-engine in subterranean use of 60 horse-power, calculated to draw a load of 7 tons 4 cwt. up a bank of 570 yards in length. Smaller steam-engines are occasionally erected under ground for the working of inclined planes, and above ground for saw-mills and other similar purposes.

At the Eppleton pit (one of the eight Hetton shafts), which I descended with the intelligent viewer, he informed me that they "drew" or raised, upon an average, 50 score of tubs of coals per diem, or 333 tons 18 cwt., the winding-engine being of 100 horse power. Again, at the Ellemore pits they raise 80 score of tubs (each tub 8 cwt. 1 qr. 14lbs.) per diem from each of the two pits. At another pit it is reckoned that they raise in twenty-

four hours 5040 corves or baskets of coals up a height of 100 fathoms. The technical engineering mode of reckoning the *duty* of their engines, is to calculate the number of pounds lifted one foot high by the expenditure of one ton of coal in the fire-box of the engine. At Hetton this number of pounds was found to be 40,642,560 lbs.

At the South Hetton colliery there are three winding engines of 90 horse-power each, adjoining the great pumping engine before named. They work in winding up the coals by two sets of ropes, each weighing 38 cwts., which are coiled or uncoiled, according to ascent or descent, from two large drum wheels. The pumping engine of this colliery is furnished with four enormous boilers, and the winding engines with two boilers to each engine. Two boilers besides are kept as supernumeraries, in order to be ready if those in use should sustain any injury. The concentration of steam-power at this great establishment exceeds that of any other single colliery. The power of 570 horses is there constantly exerted in effecting the two operations of pumping out the water, and drawing up the coal and other weights. They commonly draw coals by day, and send down provender for horses, and stores and loads, by night.

Let any one compare this vast array of steam machinery on one spot, with what would have been seen at collieries in early years. The hydraulic engine or water wheel, with cranks and vibrating beams, appears to have been introduced into colliery works in the year 1680, and into Scotland about the year 1712. About 100 years ago, this mode was superseded by Newcomen's steam-engine; but even that was not of much value in pits which were as deep as 120 yards. Suppose these primitive engines to be all that we could now erect, and such works as have been executed in the Tyne and Wear collieries could never have been attempted. What would there have been in the South Hetton shaft, which is 1080 feet deep?

The only other similar steam-engines are, as far as I know, to be found in the great Cornish mining works. I have seen both, and been struck with admiration at the great engines at the United mines, near Redruth, Cornwall. I found in both districts

that the engineers were very proud of their engines and their capabilities, and kept them much cleaner than they cared to keep themselves. They are always going about them and watching them, pouring oil here, and wiping with tow or hemp there, loosing this part and screwing up that other. They always call the engine "*She*," and seem to cherish a great affection for *her*. And if companionship begets affection between two persons of opposite sexes (as it is affirmed to do), then most surely the engineer must love his engine; for he spends nearly all his days and half of his nights by *her* side, observing *her*, and waiting upon *her* with zeal and alacrity.

The steam-engines for coal-pits are generally manufactured at some of the large engine founderies in Newcastle and its neighbourhood. In a few instances, at the largest collieries, they are made on the premises of the coal company, near the pits. In these cases there is a large establishment of smiths, wrights, and carpenters; and a large walled-in piece of ground, called a "raff-yard," is appropriated to the different kinds of work in operation. The raff-yards at Hetton and Seaton Delaval collieries, are fitted up with every convenience for the manufacture and repair of all the machinery and constructions needed for these extensive collieries. Such is the amount of wear and tear constantly occurring at the large pits when in full work, that these raff-yards are generally scenes of active business. They very nearly resemble the repairing workshops of the great railway companies, like that at Wolverton, that at Birmingham, or those at other great stations; of course the mining raff-yards are rougher, and on a smaller scale. In them, too, you see more various works, as job carpentering, wheel-wrighting, &c., &c. Lots of disabled machinery, or parts of things, are heaped up all around, from "rolleys" to trucks, &c.

From a carefully constructed table given below, I find that the total engine-power employed in the collieries of the three rivers in the northern coal-field may be given thus:—On Tyne river collieries, steam-power is used equal to 9690 horses; in Wear river collieries, 8907 horses; in Tees river collieries, the steam-power may equal 800 horses.

The PUMPS, of which there may be one or more in each pit, are of a size proportionate to the work to be done. Sometimes they are twelve, eighteen, or even twenty-four inches in diameter. If there be two or three pumps or cylinders, they are placed side by side, and supported at intervals by beams fixed across the pit; cisterns being placed at different elevations, to which the water is raised, and if possible delivered off by an outlet considerably below the surface. In some instances also, cisterns are placed at the level of feeders of water that occur at a distance of many fathoms from the bottom, and deliver some hundreds of gallons per minute, so as to save the waste of steam-power, which would be caused by allowing this water to fall to the pump, and raising it through the whole length of the pump.

The hydraulic action is exactly similar to that of a common sucking pump. The bucket in each cylinder consists of a stout rim of iron, surrounded with thick leather, and having a cross-bar, to which are hinged two valves, or clacks, opening upwards. There is also a similar contrivance made stationary near the bottom of the pump. The rods or spears, to which the working buckets are attached, are fastened (with cottars) on each side of a piece of wood, which is suspended by chains on the head of the engine-beam, which projects through an opening in the engine-house, and over the pit. It has a bracket (lug) on each side, which falls on pieces of timber, and thus prevents the rods from falling too low. To the upper part of its face the rods are suspended by a stout chain, exactly resembling that seen inside of a watch. Such is the pump construction, and it forms a very important part of the mining machinery. To avoid the inconvenience of the immense weight of the pump rods in very deep mines, there have been instances of the erection of steam-engines 100 fathoms below the surface. In the Alfred pit at Jarrow, there is a 30 horse steam-engine erected at a depth of about 130 fathoms below the surface. It is used in raising the coals up a shaft, which unites with the workings carried out at 45 fathoms deeper still. There is likewise at the depth of both, *i. e.*, 175 fathoms, being at no less a depth than 1050 feet, another steam-engine to draw the coals up an inclined plane that lies coincident with the dip of the strata.

AMOUNT OF CAPITAL INVESTED AND PROFITS RETURNED IN NORTHERN COLLIERIES.

It may be very acceptable to the mercantile reader if I attempt to present him with some information on the capital invested in, and the profits returned by, colliery enterprise. This kind of information is very difficult to acquire; for of course capitalists do not feel disposed to talk much on the matter. After all research and inquiry, and taking a general view of the entire northern district of Newcastle and Durham, I think we may estimate the total amount of capital invested in collieries to be about *ten millions of money*. The following summary table, the result of much laborious inquiry, may help to some general ideas of the enterprise and its results in the northern collieries:—

SUMMARY TABLE OF INFORMATION ON NORTHERN COLLIERIES, 1843.

Districts.	Average depth of Shaft.		Number of Pits or Collieries.	Men and boys employed.	Engine Power in Horses.	Coal raised per annum.	Prices per ton.
	Faths.	Feet.					s. d. to s. d.
Tyne River	85	510	92	12,833	9690	2,468,481	7 6 to 10 0
Wear River		450	88	11,558	8907	2,355,486	8 6 „ 11 6
Tees River		330	12	1,379	800	1,682,404	8 6 „ 10 6
In 1843.			192	25,770	19,397	6,506,371	

The lessees of coal, as well as the proprietors who work their own royalties, are very wealthy. The capitals employed in winning and working the three largest coal concerns, are not less than £500,000 each. These concerns may each comprise from six to twelve separate mines, and all the respective engines, waggons, horses, &c. The winning of a single colliery (all things included) will cost from £50,000 to £80,000, and even as high as £200,000 in extreme cases. These observations apply chiefly to the great partnerships and to the grandees of the trade, such as Lord Londonderry's trustees, the Countess of Durham's executors, the great Hetton Coal Company, Lord Ravensworth and partners, the latter partnership called the "grand allies," in

all of which there can be little doubt that the capital sunk, with machinery and plant, must approach to £500,000 each. A visit to any one of these grand concerns would enable the reader to understand the immensity of the cost.

The second rank collieries, such as Wingate Grange (Lord Howden's and partners), may perhaps equal £200,000. Thornley colliery may be about this amount; and those of Colonel Braddyl and partners, the same or more. The first class concerns will work probably from 6 to 10 or 12 collieries, of different descriptions of coal, and situated several miles apart. The third class concerns may be reckoned as single pits, with capitals of from £40,000 to £60,000 each. The fourth and most numerous class of colliery concerns may require from £8,000 to £25,000 each. These are generally engaged in the coasting trade, and for the supply of the steam coal to London, and local manufactories of various kinds. There are still smaller collieries, but they are chiefly land sale, and do not supply the general markets.

The whole of the proprietors of the three first ranks of collieries, were united in an agreement called "the Vend," a most powerful combination, associated for the purpose of limiting the coal worked and sold by each concern respectively at their collieries, according to a basis fixed by a "committee of the coal trade." The result was to keep up a higher price for coals in the London market than could have been maintained if each colliery produced and sold as much as possible. The fixing of this scale or basis of the whole "Vend" was a point of the greatest delicacy, and the arbitrator was most jealously watched by his confederates, each being anxious to secure for his own concern as large a vend as possible. The disputes arising from such questions have often been violent, and there can be no doubt that they led to the dissolution of the compact; for the whole confederacy is now dissolved, and there is now no such thing as a limited vend. The limit is now imposed by the natural adjustment of operative market principles.

When the vend was in its full force, and exercised unlimited authority, the fear of a "fighting trade" kept together those who really fought with tongues. A great dread of ruinously low prices,

waste of time, &c., kept private feuds in some kind of order. But now that the whole thing is exploded, as if by pit-gas, it has been proved that coals are not had so much lower as ye should have expected. Indeed, my wife is even now constantly complaining of the price of coals, and keeping me half-warmed in my study in winter, because "really you use so many coals, my love, we can't afford it."

As to the probable profits from those great concerns, no doubt they are diminished by the dissolution of the vend; but perhaps not so much as was anticipated. Taking the largest and most powerful coal company in the trade, namely, the great Hetton Coal Company, it has been said that it averaged a profit of from £35,000 to £45,000 per annum. The two other great concerns above named may have averaged the same profits. The others may be taken in a like proportion to their capital, or perhaps in a lower proportion. The great extension of the demand for steam-coal (*i. e.*, a coal that burns hot and quick, and makes a white ash, and is suited for steam-engine furnaces), has so revived some collieries north of Newcastle, which were considered some twenty years ago as utterly worthless, that they have become profitable concerns. On some of these collieries £50,000 or £60,000 had been spent, and it was thought in vain, but they are now made to clear from £8000 to £12,000 per annum.

Mr. Buddle, the well-known northern coal-viewer, estimated the total capital employed in the Tyne and Wear collieries at about £2,200,000.* When questioned as to profits, he said, "According to the best of my knowledge, I should think that by no means ten per cent. has been made at simple interest, without allowing any extra interest for the redemption of capital." I conversed with him on this topic at some length, and he adhered to this estimate. He had the means of *knowing* better than almost any other man. But there were some who threw serious doubts on the correctness of this view, thinking the profits much larger.

* This estimate was made many years ago. I do not think ten millions exceeds the present truth, for the entire northern district.

THE COAL WON—FINAL ARRANGEMENTS.

We now consider the shaft to be completed down to the coal, but it must be continued an indefinite distance further as a "*Sump*," to provide "*Standage*" for the water. And, as this is a necessary portion of mining economy, it is often advantageous to carry out driftings in stone or coal, so as to secure a reservoir for at least a few days' or weeks' accumulation. Thus they provide against an unexpected influx of water, or the interruption of the pumping power by unforeseen accidents. The sump, like a well, is walled if necessary.

Before we proceed, we must have had the very important question of the NUMBER OF SHAFTS decided. After what I have previously said on this point, as to the expense of sinking shafts, and in consideration of what I shall have to say, perhaps, on ventilation, it will be sufficient here to observe, that the old policy always tended to the limiting of all to one shaft. Hence arose various contrivances to make a large shaft answer the ends of two or more smaller ones. You must have either *two* shafts, one of which is called the downcast and the other the upcast; or you must make one shaft into an upcast and a downcast. This latter result was commonly obtained by dividing the single shaft with a wooden partition, extending through its whole length, and termed a brattice. I found many of the principal mines worked with subdivided shafts, and the brattice would be the only separation between one part of the working and the other.

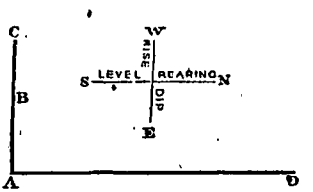
Again, in a large circular space smaller shafts were sunk close together, as may be gathered from figures, p. 102, which will show the different dispositions of shafts in the old plans. If there be only one shaft, and that be bratticed, then all things must be so laid out as to tend back to that one spot. If there be two shafts at similar distances, the plans tend to the bringing of coals to one shaft, which is called the drawing shaft, and the ventilation of the mine by the other shaft.

Then again, the DRAINING of the WORKS is a matter requiring full consideration. In almost every colliery there is a considerable amount of water, varying of course in each; in some much, in

others less. You would think that when you had *stopped* back the feeders met with in sinking the shaft, you had done with water—not so, for so soon as you begin to work the coal, or rather before doing so, and in preparation for your enemy, you must arrange the permanent drainage of the mine.

This is the constant work of the pumping engines. To carry off the supplies of the feeders met with in sinking, was only their first, and as it were apprentice work. The steam-engine, then, is erected during the process of sinking and winning, and the pumps are suspended and lengthened as the shaft increases in depth.

It will occur to the reader that the strata of every coal-field have a certain inclination with respect to the horizon, called the *dip* and *rise*, as well as commonly a level line of bearing, forming right angles therewith. We need not add the complex modifications occurring in practice. Now, as the *drainage* will generally follow the descent of the coal-measure, it will be necessary to select such a situation for the engine pit, that when the excavations for getting the coal are extended, the water, instead of accumulating in the works, may run off to the place where the pumps are brought to meet it, and to beg the favour of its company to the upper air. With this view, it is usual to sink the engine pit at the lower part of the field, the drawing shaft (if two shafts exist), being at a short distance above, on the *rise* of the strata. The annexed simple sketch will at one glance explain this arrangement.



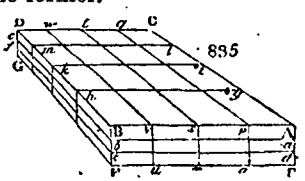
Imagine the cross lines to indicate a tract of country containing coal measures, which rise to the west, and dip towards the east, the cross bearing of the strata leaving a slight inclination from north to south. Then the course of the winning would be as follows:—Having sunk the engine pit at A, marked the lowest angle of the ground, and the working pit at B, a little higher up, and having opened a passage between them, the next operation would be to cut a drift or water-course along the lowermost level of the tract

from A to D; so that when what is called the *Winning Headway*, that is, the main thoroughfare, is excavated from A to C, and the engine and drawing apparatus got into work, the coal is said to be *won*. The waters from the workings, which are carried on the rise, mostly flow off by means of cross galleries to the sump or well (before described), in which the pump works; some portion also, it may be, running down the headway A C.

Prior to Newcomen's application of the steam-engine to raising water from coal mines, both water and coal were raised by means of engines wrought by horses, a method still in use in some small land sale collieries. Afterwards water-wheels came into partial use, with a chain of buckets. In 1708, windmills were erected to work pumps in several collieries in Scotland. In 1714, some kind of a steam-engine was erected at Byker, Northumberland; now perfect and magnificent steam-engines are common at all large collieries.

METHODS OF EXCAVATING THE COAL.

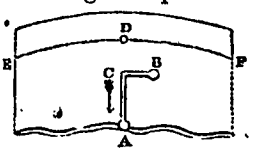
A bed or seam of coal is not a solid mass of uniform texture, nor is it always of uniform quality for burning. It is often divided and intersected with its accompanying strata, by what are named locally partings, backs, cutters, reeds or ends. Besides the chief partings at the roof and pavement of the coal-seam, there are subordinate lines of parting in the mass of coal of variable dimensions inseparable to the former.



In the adjoining figure, these divisions are displayed. The letters A, B, C, D, E, F, G represent the portion of a bed of coal. The oblong (parallelogram) A, B, D, C shows the parting at the roof; and E, F, C, the parting at the pavement. The letters *a b*, *b c*, *d e*, and *e f*, are the subordinates, or intermediate partings; and the letters *g h*, *i k*, *l m*, show the backs; and the letters *o p*, *p q*, *r s*, *s t*, *u v*, and *v w*, are the cutters. It is thus clear that, according, to the number of these natural divisions, a bed of coal is sub-

divided into solid cubical figures of various dimensions. This is another mark of benevolent design by the Creator, which, perhaps, has never before been adduced as such. This disposition in the coal-beds to separate into cubical shapes, is precisely what man requires to assist him in its extraction.

When the engine-pit is sunk, and the lodgment found, a mine is then run into the coal to the rise of the field. This mine may be six or eight feet wide, and is carried as nearly parallel to the backs as possible till the pit is gained. The figure represents this mining operation. A is the engine-pit; B, the second or bye-pit; A C is the gallery division at right angles to the backs; C B is the gallery set off to the left hand parallel to the backs; D is a point assumed as a dipping from the crop of the field, and the level lines from that point will be parallel to the line of crop, as the lines D E, D F; also the levels from any point whatever a dipping will be parallel to these. Hence, were the coal-field an elliptical basin entire, the dip head levels carried from any point would be entirely elliptical, and parallel to the crop. Thus, the carrying out of a pit is a matter of serious study, and must conform to the cleavages of the coal, and the disposition of the coal-field.



In British practice there are four different systems of working coal mines:—

1. Working with pillars and rooms, styled post-and-stall, where the pillars left bear such proportion to the coal excavated as is just adequate to the support of the incumbent strata.

2. Working with post-and-stall, where the pillars are left of an extra size, with the intention of subsequently removing a considerable proportion of each massive pillar, when the regular working of post and stall has been finished in the colliery.

3. Working with post-and-stall, or with comparatively narrow rooms or boards, whereby an uncommonly large proportion of the coal is left with the view of working back towards the pits, and then taking away every pillar completely, if possible.

4. Working by the long way, or the Shropshire method,

which leaves no pillars, but takes out all the coal progressively as the workings advance.

The post-and-stall system is practised with coals of every thickness. The Shropshire method is adopted with thin coals, which do not exceed, say, six or seven feet.

To simplify the method still further, I might arrange the different systems of working the coal under only two heads. The post or pillar-and-stall system, and the longwall system of working.

The *pillar-and-stall* principle is carried out in the working away of a certain portion of the coal as a first measure, and the leaving of the remainder in *pillars*, either to be left permanently for the support of the roof, and therefore lost as to their coal, or to be at some future time partially or totally removed. The form of these pillars, and the proportion of the coal to be eventually obtained, cause much controversy amongst miners, and, indeed, embrace great commercial interest for the coal market.

The principle of *longwall working* is the extraction of all the available coal by the single process of first working, maintaining the roads by means of stone walls or wooden props. This system does not admit of much variety of operation. It is applicable only, with advantage, to thin seams lying near to the surface, and in which the workings may be of a very limited extent. When you consider the amazing subterranean distance traversed by some of the great northern mines, you would find this system (if you had it described to you in detail) to be quite inapplicable. Take the instance, perhaps of the greatest extent, that of the Howgill colliery at Whitehaven, Cumberland, the property of the Earl of Lonsdale. This colliery is said to extend over an area of 2,300 acres, exceeding, probably in this respect, any other in the kingdom. The *longwall* system is liable to many practical objections, such as the difficulty of maintaining the roads to any great distance, the impracticability of forcing the ventilation so perfectly as to pass through *troubles*, or to command sufficient wall face for the production of more than six or eight thousand tons per working day to the shaft; and lastly, the ruinous effect of pressure upon water-courses, all of

which difficulties contribute to the necessity of numerous sinkings, and a perpetual change of establishment.

One of the most extensive workings on this system is in the neighbourhood of Edinburgh, at the Edmonstone and Sheriff Hall collieries, in seams of four and five feet in thickness, with both good and bad roofs. The coals used to be borne by women, in great degradation, and labouring as hard as men. The thin coal and ironstone mines in Staffordshire are worked in a similar manner, and this system is universally applicable to the working of ironstone. There is also the Yorkshire longwall method of working mines. All over Yorkshire you may find mines thus excavated.

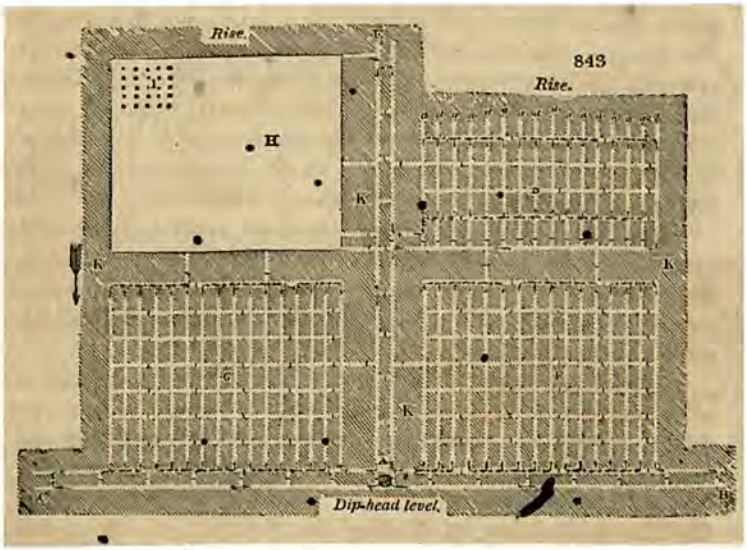
There are two models of the two chief systems of working coal standing on the ground floor of the Museum of Economic Geology, in Jermyn-street, London, which would at a glance afford a notion of the longwall, and the Newcastle or pillar-and-stall system. One of these models I saw in the Crystal Palace, and many may recollect its form.

METHOD OF WORKING COAL ON THE NEWCASTLE SYSTEM.

It was chiefly owing to Mr. Buddle, so often mentioned, that the present admirable Newcastle system has been perfected. This system is named *panel-work*, because the whole area is divided into quadrangular panels, each panel containing an area of from eight to twelve acres; and round each panel is at first left a solid wall of coal, of from forty to fifty yards thick. Through the panel walls, roads and air-courses are driven in order to work the coal contained within these walls. Thus, all the panels are connected together with the shaft as to roads and ventilation, and each district or panel has a particular name, like a city square, or block of houses, so that any circumstance relating to the details of the colliery can be readily referred to a specified place.

I adjoin a plan of a large Newcastle colliery laid out on this principle. By studying it the reader will be better able to receive my various observations on the pits.

For distinctness I show the lines of the boards at right angles with the dip-head level, or level course of the coal. A is the engine shaft divided into three compartments, an engine-pit, and two coal-pits. One of the coal-pits is the downcast, by which



the atmospheric air is drawn down to ventilate the mine; the other is the upeast shaft, at the bottom of which is the rarefying furnace. B C, is the dip-head level; A E, the rise or cross galley; K K, the panel walls; F G, are two panels completed as to the first work; D, is a panel, with the rooms *a*, *a*, *a*, in regular progress to the rise; or, in simple terms, where the hewers are at work in heaving down the coal. H, is a panel fully worked out, and from which nearly all the coal has been extracted; the loss by this plan amounting to no more than about a tenth, instead of a third, or a half, by old methods. In H you may conceive the *goaf* or great gasometer to be situated, of which more anon.

By this plan the pillars of a panel may be worked out at any time most suitable for the economy of the mine. Before this it was a common misfortune for the pillars to sink into the pave-

ment, and to derange that whole portion of the mine. This was *crush* or *creep*, which I mean to explain presently. In this plan, when the pillars of a panel are to be worked out, one range of pillars, as at 1 and ft, is first attacked, and as the workmen cut away the furthest pillars, props of wood are placed between the pavement and the roof within a few feet of each other, as shown by the dots at 1. This is continued till an area of 100 square yards is cleared of pillars, presenting perhaps a body of strata 130 fathoms thick, suspended clear and safely, and you may walk about as well there as in any thick wood; though, perhaps, it is not quite as pleasant, there being no leaves on the props, and no birds amongst the trees and the leaves—except *blackbirds*.

When mines are fully worked, the main shaft is frequently continued down to other seams of coal, which are excavated in the same way as the first seam. In such cases the workings communicate with each other by shafts, called "staples," which are sunk at intervals between the seams of coal.

The illustration will be sufficiently indicative of the shape a mine assumes in the course of its development. It may be further likened to a small-paned oblong window laid flat on the ground—the panes of glass representing the pillars, and the panels of wood the passages of the mine. I might venture on a bold flight of illustration, by likening the workings of one of the oldest and largest Newcastle mines to a portion of the city of London. Let us imagine St. Paul's dome and tower to represent the shaft—the height will be even less than the depth of many of the shafts. The top of St. Paul's, then, shall be the top of the shaft—the banksman standing at the cross—the great dome is the shaft's greatest circumference, and the whispering gallery the place where two loads of talkative men are passing each other; the churchyard is the bottom of the shaft. To this place all the corves or tubs of coal are brought from all the passages of the pit, the main way being shown by Cheapside, the omnibuses and vehicles being the train of coal-waggons, coachmen the drivers, and cads the putters; the side streets running down to the Thames are the various passages, such as Bread-street, Queen-street, and, on the opposite side, Foster-

lane and King-street. Putters of all kinds are pushing the loads up these streets. If you please, the Bank of England shall be one place where the hewers are at work, and the clerks shall be the hewers, having pens instead of picks. From the Bank come the coals down Cheapside, and also from the side streets, and all come up to the Cheapside corner of Paternoster Row. "The Row." I can only liken to the "winning headway," or first passage driven for entering the mine; but if it be a *winning* headway, it is only such to—the Publishers!

Finally, imagine all the corves or tubs to be drawn up from the yard to the top of the cross; and fancy them ascending the whole height of the dome and tower up even to the cross, and then recollect that, for your instruction, the author has oftentimes descended that same, and twice that same, and three times nearly *thrice* that same depth underground—for I have descended three shafts of the following depths—1044 feet, and 1070 feet, and 1600 feet.

The extent of the galleries of some of the older coal-pits in the north is very great. According to the remarks of Mr. Wood, Killingworth pits must have nearly 160 *miles of gallery excavation!*

At the Howgill pits, west of Whitehaven, the mining has been carried more than 1000 *yards under the sea*, and about 600 *feet below its bottom*. When after one subterranean perambulation you come to the under-sea part of the workings, suddenly the guide will stop, look at you as knowingly as a pitman can look, and then in solemn tones inform you that you are "under the heverlasting ocean," and then he very broadly hints that it would be desirable to drink your health there, which he assures you he can do if cash be found. This being found, he pulls out a bottle, and drinks your health and safe return.*

* A pitman in the north confidentially delivered it as his firm belief, that the earth was a huge living animal. "It's my opinion, sir," said he, "that the earth is alive, and that she has a circulation through her veins; and I do believe if they go on cutting into the earth's vitals in this way, they'll some day cut the *jugular vein*, and then, sir, there will be an end of this world!" I suppose he had formed some such notion from the fearful flood in the Whitehaven pits, from undermining the sea too closely and deeply.

In this last vicinity, a shaft has been sunk 999 feet, passing through seven workable and eighteen thin coal-seams, the former amounting to upwards of thirty-five feet of coal. In 1844, there was in progress at Whitehaven a most extensive coal-winning, intended to be the deepest sinking, and the most extensive drifting in the kingdom, in order to prosecute the working of what is there called "the ocean coal." The conveyance along the horizontal stone drift was to be accomplished by engine power, either stationary or locomotive, and the seams to be won were the main band ten feet, and the bannock band seven feet thick.

At one colliery, near Newcastle, the passages are more than twenty miles in extent, with an average area of seventy feet.

St. Hilda colliery, near South Shields, has underground workings of the mine equalling full seventy miles in gallery extent.

ROYALTIES OF THE NORTHERN COAL-FIELD.

The Royalties of the coal-field in the north are very extensive. It is said that thousands of acres of coal are held unworked, under high "dead rents," so as to prevent their being appropriated by other parties, and until time brings them into the course of working. In the county of Durham the coal is very much in the hands of "the church;" and there are some ill-natured persons who will explain how the church adopts the thriftless and mischievous system of life-leases, and fines on renewal every seven years. The consequence is (say they), that it is the interest of the lessors, for the time being, to work out as much as possible of the fee-simple of the royalties, and to leave the bones to their reverend successors to pick. What can you expect on such a plan, but all for their life interest, and none for those who are to follow? What in the world has posterity done for them? Why should they do any thing for posterity? Even individual rectors, having found coal under their small glebes, are working it out against their own lives, and impoverishing the livings for their successors. I am only here repeating what has been told me by churchmen, and *not* repeating a good deal more. Those who take pleasure in scandal may hear, if they please to visit the vicinity, some strange stories of sales and ex-

changes of valuable coal-royalties, both by bishops and chapters, for not much more than the fiftieth part of their value. I used to think old Durham cathedral frowned upon me when I listened to tales of this kind within sight of it. However, I don't repeat them.

Only one thing will I add on this sore topic, namely, that it has been asserted that, if the Church's income were properly secured to it, and managed for it, there is ample mineral wealth in the county to erect and endow a sufficiency of churches for the whole population of Great Britain. Hark now, how angrily that old Durham tower bell strikes out the hour of ten o'clock! What business had I to listen to such malicious tales? "One, two, three, four, five, six, seven, eight, nine, ten," and a loud boom, as much as to say, "If you don't be charitable I'll strike *eleven!*"

Several thousand acres of coal are generally held under lease by the proprietors of the largest collieries, the rent being compounded of a "certain" annual rent, and an additional ten-tail rent for each ton of coals (equal to eighteen and a half Newcastle chaldrons of fifty-three cwt.) sold beyond the quantity stipulated for the certain rent. These ten-tail rents are mostly between 14*s.* and 24*s.* per ton, according to the value of the seams, and the difficulty of reaching them.

PILLARS AND THEIR DIMENSIONS.

Pillars were formerly left whole in the mines; but in course of time, when pillars were found to be still upstanding, they were frequently reduced by a second working, which caused the removal of one quarter, or one half of the pillar; but this process scarcely ever failed to produce a *creep*. The operation could be performed with the light of candles safely, and no great falling of the roof occurred until the whole mass was set in motion. This pillar-working is at the present day pursued in northern mines. Much judgment is required for this work, and it is a very interesting process to miners; but I am much afraid I should not get my readers sufficiently animated to take leading parts in a discussion as to the best methods of getting the pillars by *ribs* or *jenkins*.

About fifty years ago, the attempt was made for the first time to remove a part of the pillars, and a method was devised by which fifty-four per cent. of the coal was obtained. This method succeeding, afterwards alternate rows of pillars were abstracted, and sometimes even half the intermediate ones. Lastly, Mr. Buddle invented the method called *panel-work*, by which nearly the whole of the coal may be obtained with safety.

This *panelling* consists in dividing the mine into districts or *panels*, separated from one another by walls of coal forty or fifty yards thick, and extracting the coal from each of such panels in succession; usually beginning with the one most distant from the shaft, and then completely shutting off all communication with the rest of the mine as soon as any panel is worked out. Large pillars are at first left between the *boards*, which are four yards wide, and the transverse galleries, which are two yards wide. The dimensions of such pillars are about 12 yards by 24. As soon as the galleries are finished, and the work of removing the pillars commences, the roof is at first supported by stout props of Scotch fir, and when these are taken away the roof falls in. This is, in fact, the completion of *pillar-and-stall*, or *board-and-pillar working*.

In order that I may show the proportion of the pillars; to the coal extracted, let me append a small scale for first working, with design of afterwards taking out the pillars, the width of the principal workings being five yards, and of the cross holings or passages two yards.

SCALE FOR PILLARS IN A COAL-MINE.

Fathoms deep.	Size of Pillars in yards.	Proportion left in Pillars.
80	22 by 8	.57
100	22 by 9	.59
120	22 by 10	.61
140	24 by 11	.63
160	24 by 12	.66
180	26 by 14	.69
200	26 by 16	.71
300	30 by 24	.82

Add to the above the extreme case of the deep Monkwearmouth colliery, where the size of the pillar is 40 yards by 30, and the proportion of coal left in pillars is 80.

According to a little sum which the viewer of Monkwearmouth worked out for me at the pit, things stood thus in that remarkable colliery: only one-seventh of the coal was taken away, or nearly that amount—leaving about six-sevenths of the entire coal in the pit to support the roof, &c. What a small reward is *one-seventh* of the coal-seam, in sinking to which from £80,000 to £100,000 have been expended in a single shaft!

"CREEPS," AND "THURSTS," AND "DRAWING THE PILLARS."

In the deep collieries of the Newcastle district, before the mode of combating with inflammable gas and water was as well understood as it is now, the working of the pillars was not contemplated at all; so that the skill and judgment of the viewers and miners of that day was only directed to procuring as much coal as possible by the first working, leaving merely as much in pillars as would support the roof, and no more. With this view, in all the valuable Wallsend colliery, the quantity of coal taken away varied between one-half and one-third, leaving respectively in pillars from one-half to two-thirds of the whole mine. This mode of working produced the desired result during a number of years; but as time progressed these pillars naturally weakened, and the floor of the mine became softened by water, and very generally throughout the northern district what are called *creeps* were produced.

What is a creep? Well, it is very significantly so called, for it is a creeping up of the floor towards the roof of the mine. It is a certain protrusion or bursting upwards of the floor of a mine, owing to the small extent, and consequent liability to sink, of the bases of those pillars of coal which are left to support the roof, during the excavation of so much of the seam as appears compatible with the safety of the pitmen. Now the process and course of this creeping is very curious, for it shows progressive stages. You may see in old mines the creep in its infancy, its

youth, and its manhood, growing up gradually from a little rise in the floor, like a gentle ripple in the level of the ocean to a swelling wave, until its point or crest just begins to touch the roof. Further on, this point touching the roof will be enlarged into a broad surface. This gets broader and broader, and the peak of the ridge becomes flattened by pressure against the roof. By means of this pressure, the *creep*, from creeping upwards begins to creep outwards. From being a slim youth it is becoming a fat man. Imagine to yourself this growth going on in the filling up of a square vacancy, and you will get to conceive the final process of a full creep. This occurs when the pillars refuse to take any further part in their special resistance of the superincumbent strata. Then the creep or crush is sure to become *dead* or settled. In this state the mines formerly were considered quite unworkable. But the Davy lamp has enabled men to work even "crept boards" if otherwise desirable. I here adjoin a diagram showing the progress of a creep.

1. First stage of active creep.
2. Second do.
3. Third do.
4. The metal ridge closed, and the creep beginning to settle.
5. The creep settled, the metal ridges being closely compressed, and supporting the roof.

A *creep* to me was an interesting thing. How suggestive of what is going on in the great works of life above! Creep is only "high life below stairs." It is only the servant—the floor, wanting to become master—the roof. In fact, creep in coal is socialism and democracy in society. All goes on well while the floor is content to be a floor, and while the pillars are content to support the roof. But when the floor says to the roof, "Come, come, Mr. Roof, I want to creep up to you, and I shall break up the whole thing to do it." And when the pillars begin to exclaim, "Come, come, Mr. Roof, we've supported you long enough, and you don't seem a bit better than the floor, and we don't see why *we*—the poor pillars—should bear all the burdens; so we shall

give up, and do you therefore look out; you must uphold yourself, Mr. Roof." Why, then, of course up goes the floor, down go the pillars, and down comes the roof; and who is benefited? Not the pillars who would not stand, nor the floor who would not lie still, nor the roof who is compelled to come down; no, neither of them, but all are involved in one common ruin! Yes, yes, there's much instruction to be got out of a creep in a coal-pit. The only thing to do is, to moralize away from it, to creep out of it before you *improve* it, for otherwise a mass of the roof may come down on your head with any thing but a creeping force, although it may be only the *result* of a *creep*.

In modern mining practice, the evils of creeps are mostly avoided by providing *barriers* of coal in such situations as to divide the coal-field into convenient districts, so that, even if a creep or other casualty shall take place in one district, it cannot extend beyond the barriers. Thus all *general* creeps may be provided against, and as the pillars are worked in limited quantities at each position, the coal is less damaged by pressure, and ventilation is more conveniently effected.

The introduction of the Davy lamp has enabled the intrepid miner even to work out the portion of coal thus fearfully blocked up by creeps. To get the remaining coal, the first process is to dig through the rubbish. After this, to prevent the exfoliation of the roof (the peeling off), it is propped up with posts of timber. This method is pursued until the whole of the coal is extracted, when the props are removed if their removal is safe, and then the superstrata break down *en masse* into what the miners term a *goaf*, and thus finally fill the space previously occupied by the seam of coal.

The last process is one of peculiar dangers, and is termed "drawing the props." I once witnessed it in an old deep pit. We stood under the roof of an excavated creep. All the coal had been got out from the creep that could be extracted; and now the props of wood were so numerous that it was determined to extract them, or every second one; sometimes every third or fourth prop is extracted, according to the expected danger. I watched with some anxiety the men knocking down with a

heavy hammer one prop after another. They waited some minutes between each prop to discover if the roof would bear another's extraction. I did not feel at all comfortable; for, whenever a prop was knocked down, I felt that I might be knocked down in like manner by the falling roof. The men, however, were used to this work, and seemed pretty easy at it. Only Davy lamps can be carried into these dismal and dangerous recesses; and I felt my Davy shaking in my hand, and I felt myself shaking too, when I saw its flame enlarging suddenly (when the props were falling), owing to the liberation of inflammable gases by the partial fracture of the coal. I was not sorry to get out of this prop-drawing place, and was remarkably pleased with every narrow passage, in comparison with that wider one where the props ceased to perform their office.

The effects upon the surface of the ground produced by creeps in the mine, greatly depend on the depth of the coal, as well as upon the extent crept over. When that extent is great, although it may be at a depth of 120 or 130 fathoms, the surface is affected even to the cracking of the earth, and the damaging of buildings. This often occurs from the very gradual way in which creep progresses; for it is by the settling down of the earth under one part of a building, before another part is effected, that the damage is done. But it is no uncommon occurrence to find that fractures take place soon after the creep over the whole area is completed.

Thursts are different from *creeps* in this way: When pillars are left very weak and thin, and the floor of the mine is dry and hard, so that it will not yield at all to the pressure, the pillars themselves are crushed to pieces, and ground into small coal, thereby occasioning the fracture of the roof, which may affect the surface, or the seam of coal lying above the one in course of working.

I have seen *creeps* in progress and complete; but the most curious thing is to *hear* the noise made by the first bursting up of the floor. This pitmen often hear; I only heard it once in, I think, Heaton pit. It is said that the congregation in a church near Newcastle, were one Sunday morning plentifully

powdered with chips from the white ceiling of the church, which had been *crept under*, being above an old mine. "It's only the pit a-creeping," said the parish clerk; but it would not do, for there was a sudden *creep out* of the congregation. The clerk went out last, with a powdered head, crying out—"It's only a creep!"

I suppose the reader will now be anxious to see the inside of a pit. It is a difficult matter to make darkness visible, and our deeds in darkness entertaining and instructive. However, we must now descend the mine, and do our best. Perhaps a little poetical prelude will be acceptable: conceive this invitation to be fresh from the north.

DESCENT OF A COAL-PIT.

(*Pitman.*)

"Come stranger, come, and see the pit,
It cannot do you any harm
To see how we, by work and wit,
Through all the winter keep you warm.

"Come stranger, come, look round at bank,
And view the engine, pumps, and shed;
See the coals landed here, and thank
Your stars you're not a pitman bred.

"This is the mouth, then, of the pit,
And though it smokes and looks so black,
'Tis nothing when you're used to it,
And you'll go down it in a crack.

"Now, banksman, send a message true,
Put on the empty basket token,
Let ne'er a corf of coals come through
Lest this here stranger's bones be broken."

(*Banksman calling down pit, and sending a message.*)

"Ho, ho—down there—ho, ho, ho, hoh!
Two gentlemen a coming down;
Just push aside them corves below,
And make the stranger pay a crown.

"The one's our viewer, t'other man
Is somebody they *will* conceal,
They say he's com'd to draw a plan
Of how you pitmen work and feel.

"Tom says he's got a sight of cash,
And buys all sorts of curious stones.
So make him pay, or let him smash,
And send him up with broken bones!

"Just send them hewers word below,
And bid 'em get at least a crown;
And if he won't fork out you know,
Why, when you get him keep him down!"

(*Author—having overheard—to Banksman*).

"Pray, Banksman, what is that you're crying?"
"Oh, sir! I tells 'em all to be
Most civil, and to keep from lying,
And treat you as they would treat me.

"Now, if you please sir, all is ready,
The corf is waiting, just step in;
Give me your hand, sir,—there now—steady—
Farewell till round the pit you've been."

DESCENT INTO, AND DESCRIPTION OF, THE DEEPEST COAL-PIT IN BRITAIN.

Which of the coal-pits in this county of collieries would you like to descend, gentle reader, in my company? Choose your pit; for a choice of evils is better than no choice. Shall it be Jarrow pit, hard by Jarrow Slake, where the man used to hang in chains? Well, then, I must see Mr. Jobling, the viewer, and arrange for a couple of breakfasts to-morrow morning, and a couple of pit-dresses for the occasion.

Or if you prefer to descend the celebrated Monkwearmouth pit, near Sunderland, I will see Mr. Elliott, the intelligent viewer there, and perhaps his brother will accompany us. True, it is a hot and fatiguing pit, but, on account of its great depth, it is the marvel of the district. There you will find one of the greatest triumphs of faith in the district. Faith, in the best sense, goes upwards; but I am speaking of the Messrs. Pembertons' faith, which went downwards; and that to a greater depth than any scientific faith ever went before. Well, then, let it be Pembertons' pit at Monkwearmouth—that is, across the river, near Sunderland. We must take the train from Newcastle to-night, sleep at Sunderland, and be at Mr. Elliott's little lodge early to-morrow morning.

"Where are you going to, Sir?" says the railway clerk. "Well, I believe, towards the earth's centre," I reply. "Beg pardon, Sir, what station did you say?" "Well, come, Sunderland." Now

we are off—station after station do we pass, from Brockley Whins to other odd names and barren posts. Nothing but coal, and sand, and dusky wastes about here. And all the second class passengers subsist somehow on coal, or the collieries—on the men who get the coal, or the men who convey it. Add, if you please, glass and glass-houses, and that most aspiring chimney, which soars out of the alkali works, and carries its poisonous cloud right up into the pure heavens. Not a tree can lift up its rejoicing leaves within the reach of this cloud. The chimney stands like an obelisk in a barren desert. And yet that withering and wasting cloud has no such formidable appearance. It seems of a milky whiteness, or of a skim-milk consistency. What is there in it? Go and ask the trees of the field, or rather their blasted trunks. Go into the cottages of the work-people round about that chimney. Well, the heavens above are not polluted. There are secret chemical works up there, that quietly and rapidly undo the operations of the chemical works below; and that very poisonous volume of vapour is returned to earth in refreshing showers. What an emblem of heavenly mercy in highest things! educing good out of man's evil—man's wickedness, and baseness, and corruption, ever steaming up to heaven; but yet in prolonged pity, there neutralized, and still for an appointed time nothing but perpetual blessings descending upon perpetual evil-doers! But we have passed the chemical works, and all other objects, and here we are at Sunderland. What a bridge is that iron bridge over the Wear! Now, stand down here and tell me, fellow-traveller, did you ever see any thing so like a spider's web flung airily in mid air across a stream, as that bridge? It is all iron, but yet seems all filigree work; and how nobly and proudly the ships seem to sail under its one stretching arch, without doing obeisance to it by lowered masts! The little streamer on the top-mast of that brig, now sailing under-bridge, seems to be sporting with the light iron circles that fill up the spandrils of the arch. In like manner to this bridge, poetry can throw a charm over the darkest waters and the dullest commerce. But now let us pass over the bridge to our hotel. Let us leave our carpet-bags here—and now we have had our refreshments, let us go over and see

Elliott at the pit, and I will introduce you to one of the Pembertons.

"Mr. Pemberton, permit me to introduce to you my friend, Benjamin Wriggleton, Esq., of Wriggleton Park. He has a strong desire to visit the pit, Sir, to-morrow morning. You will have no objection, I trust, to permit us to go down?" "Well, Mr. ——, you know it is not usual, nor is it very pleasant for gentlemen; but as you press it, Sir, we shall be happy to accede to your request. Mr. Elliott will arrange for your descent." Now, Wriggleton, away to Elliott. There he is—a nice, kind, intelligent-looking man, of middle age. He knows much about pits, and has invented an anemometer. He lives at Pensher; this is his brother's lodge. "Mr. Elliott, my friend, Benjamin Wriggleton, Esq. We propose to descend the pit to-morrow morning, if you would make your visit late enough for us." Mr. Elliott pauses. "What time will suit you, Mr. ——? say five o'clock?" "No, thank you, Elliott, say nine o'clock, if you please." "Well, Mr. ——, say nine then, though I ought to be down pit by five."

"Now, Wriggleton, my friend, I am going to call on Dr. Clanny, one of the most benevolent men in these parts. Come with me. Some vindicate for him the invention of the safety-lamp for mines. You shall see such a forehead, on such a noble head, and such a benevolent countenance!—— Well, now, I think we had best go to sleep for the night. We must breakfast at seven or half-past seven to-morrow. Good-night."

"Good-morning, my friend, how are you? Now, fall to breakfast. See that rasher of bacon, these eggs, this tea, all cooked and heated by the very coal from the very pit, perhaps, you are going to visit. Have you done? Come along. Bring your great-coat; you will want it when you come up. Don't you think the iron bridge looks even brighter this morning? There, there is the tall, black, cloud-emitting chimney, which stands both as an engine-house chimney and a mine mark—it directs us to the pit's mouth. A few dusky sheds, and several large coal-heaps, blacken upon our view. Now, we draw near, and distinguish the pulleys overhanging the shaft, and showing by their conspi-

cuous revolutions that the pit is at work. Just come round this black shed—here, this way; this is the 'pit-heap'—get up this slope. There is Elliott, I see, talking with the banksman. Good-morning, Mr. Elliott." "Good-morning, gentlemen; step into this cottage down here, and you will find two pit-dresses for you."

"What, Wriggleton, is that you? Well, I've seen a good many changed by a pit-dress, but you beat them all." "I tell you what, P—, if you had not spoken, I should not have dreamt that was you; on my honour, I took you for some old collier who had come to see us down. I say, what do they call that man at the pit's mouth there; he seems a sort of governor of the black ones?" "They call him the banksman; that is, a kind of foreman of the labourers at the surface. He takes under his charge, as his special vocation, the dismissing down, and receiving up, all those who descend and ascend the shaft; and he may be styled the receiver-general of all receipts for and from the mine, whether consisting of live or mineral stock. Presently he will call down the shaft that gentlemen are coming down, and you'll hear such a peculiar ringing drawl as will arouse you. There, hark!" "Ho, ho, hoh—ho-h, clear away—a-w-a-y there! Viewer and gemmen a-coming—hoh—hoh!"

While they are clearing away there, we stand on the pit-heap, and look round on some scores of active boys, busily employed in wheeling the coal-baskets or tubs from the banksman, who has landed them from the shaft, to the screens, which are ranged in long upright rows; and against their sounding wires you now hear the volleys of coals rattling every minute. From this procedure arise those clouds of coal-dust for the torture of our wondering and watering eyes. These clouds settle down in the end over the unfortunate grass, that tries to look green, while the coal-dust compels it to look black. Now, while you are standing on the pit-heap, a minute or two before descending, just think what is before you, and beneath you, and only listen to what is sounding all around you. The steam-engine puffs and roars, and so does the banksman; the screens rattle and creak, and so do the loose, lumbering sheds; the iron wheelbarrows clatter and grate,

and so do the coal-waggons, and even more noisily. You look round for refuge, and your eyes are filled with coal-dust; you would lay hold of a post to keep up your courage, but there is not one; you look down to the ground to avoid ugly objects, and, lo! the pit-mouth yawns beneath your feet; you sigh for a few friendly greetings, and you hear nothing but "puff, puff! bang, bang! clatter, clatter! squeak, squeak! and rattle, rattle!" and now, above them all, in hollow tones, the doubtfully-welcome words from banksman, "Now, gemmen, the tub is ready—step in, if you please."

"Come, my friend; Elliott and I will get into this tub first, then you come after." Now, this said tub is a large iron bucket, capable of holding all the lords of the admiralty, and it is no pleasant thing to have to step into it from the edge of *terra firma*, while it is swinging over a black depth of nearly eighteen hundred feet, with nothing between its bottom and the bottom of the shaft. If the bottom *should* give way, you would at once solve the problem of the ratio of accelerated speed of a falling body—a body falling *in vacuo!* However, get in you must—give me your hand; how you shake!—don't be so nervous—you are safe enough. "Stand away there—off." Now we are descending. People who go up in balloons affirm that they have no feeling of motion, but that the earth seems to be flying away from them, while they are sitting still and resting. Much the same may be said, in reverse, of descending a coal-shaft. You have no sense of descent; but the little round hole of light seems to be flying faster and faster over your head upward, as if it were going to the skies; and at length—in a couple of minutes, perhaps—the orifice of the shaft has apparently turned itself into a day-star, which shines far, far above you in the firmament, and which you may gaze at, like an astronomer, until one or more drops of coally water fall into your up-turned eye, and convince you that man was not born to look upwards at all times with benefit, despite of what some poet says about his contemplating the stars with sublime countenance.

The first occurrence that brings you to a consciousness of your own rapid descent is, if it so happens, the up-coming of another

load, and the passage of that load by you; including, as it does, if a load of live human stock, some one with a candle. You hear a low murmur, the next moment you see a dim light (any thing rather than "a dim religious light"), and some half-human oddities flit past you with the dim light, and you can watch it swiftly vanishing up the shaft—always provided you do not catch a drop of coal-water in your eye. And now, before you can have thought it, you come close to the bottom. You have been about four minutes in descending. Now you feel a full stop, which convinces you that you have previously been in rapid motion. A kind of hollow clanking strikes upon your ears; a damp archway is above your head, a feeble oil-lamp hangs up in a corner, half a dozen whity-black beings are grouped around you. Elliott jumps out first, I get out after him, and we touch the bottom.

I have omitted one peculiar misery of this very shaft, because I did not want to smother you with smoke too soon; but, the fact is, this same shaft is nothing less than a wonderful chimney of eighteen hundred feet depth! It is an upcast shaft, and the ventilating furnace is at the bottom. All the "return air," charged with various impurities, and all the furnace smoke (and an immense fire is kept roaring in that furnace), ascend through this shaft which you have been descending. No wonder a companion of mine, in descending, dropped down to the bottom of the tub. He says he felt half choked as soon as he began descending. Another minute, he declares, would have made his wife a widow! Well, it is no trifle to go down an upcast of this enormous depth, and to be every moment getting nearer and nearer to the roaring furnace, a glimpse of whose glowing brightness you get on one side as you pass by. Going up in a balloon is nothing to going down this shaft; for in the balloon you rise continually into purer air—in the coal-shaft you sink continually into fouler gloom and more fiery darkness.

Now, that we have accomplished a safe descent of this well-known shaft, we may say something about it. Accurately, its depth is 265 fathoms to the Bensham seam, and 15 fathoms lower to a reservoir of water; that is, in feet, 1680 in all. I say we

have descended, in round numbers, 1600 feet. This does not sound so much in words as it seems in descent, or would appear in visible length. The readiest way to apprehend it is, to suppose the Monument of London piled seven or eight times upon itself, and that, when you had thus reared it to seven or eight times its present altitude, you had to descend from its summit to its base in an iron tub. Imagine that you were descending inside of the building, that it was hollow and all dark, and that there was a roaring furnace at the bottom, and that a volume of foul and heated air was ascending while you were descending; then, I think, you might gain some notion of the descent of this coal-pit. Or you may take the shaft as four times the height of St. Paul's dome. The ordinary time in going down or coming up the shaft, is from two to three minutes respectively. Men and visiters are let down more slowly. The tub in which we travel is seven feet high. It holds 105 (Newcastle) pecks of coal, and the weight of these 105 pecks, by themselves, is 30 cwt. The ropes which bear and bring this tub are, of themselves, objects of curiosity. A pair of ropes is used together. The load of coal and carriage upon them averages 36 cwt. at a time. The average speed of drawing by the rope is 13½ feet per second. The weight of the pair of ropes themselves, is no less than 5¾ tons; and the price of the pair in use when I descended, was the sum of £550 : 12 : 6. These particulars were given me by the intelligent viewer. He also admitted that the descent or ascent of the shaft, nearly always produced a sensible weight on the drum of his ear. The shaft is divided or "bratticed" into two compartments, in the other one of which the pumps and their apparatus are placed. The engineers alone descend that compartment.

After all, the descent of this shaft (the shaft alone) is not so much more terrible than that of any of the deeper upcasts in the district. All upcasts are unpleasant, and peculiarly so to strangers. I was, however, a little surprised to find that one of the oldest colliery-viewers in the north neither had, nor would, as he told me, on any account descend this shaft, and advised me not to do so. But the romance or novelty connected with it would have

carried me double the depth, if possible. Few visiters (if any) to the mines go down this pit; and perhaps not one would desire to descend it, if they were to see the whole depth of it drawn out visibly upon the surface; or if they were to stand under St. Paul's first, and to multiply its height by four, or under the Monument, and multiply its height by eight, by way of gaining some idea of their projected trip.

I have, in describing the course and costs of coal-mining, already mentioned the peculiar and unprecedented difficulties met with in sinking this shaft. The coal there lies about the centre of the great coal basin, and therefore in that neighbourhood the deepest shafts must be sunk. By the various sinkings made, we have gained a knowledge of the position and form of the entire basin. Its general shape is rather oval than round. The deepest pits are those of the northern sea-coast of Durham. In the northern coal portion of Northumberland we find coal at a depth of 80 fathoms; the Cowpen pits average about 100 fathoms, and the Hartley pits 50 fathoms.

But near South Shields, and in Durham, coal is drawn from a depth of 200 fathoms, and 220 fathoms; and in this pit of Pembertons', from 265 fathoms beneath the earth's surface. From my description of dislocations in the coal strata, it will be at once understood, that all the pits in any one district are by no means of similar depth. A fault may throw up coal much nearer to the surface, even close to a deep shaft; the latter having been sunk where there is no fault, and where the coal lay at its primitive depth, and in its due position in the basin.

Wriggleton is now recovered so far as to stand upright, but not so far as to see clearly where he is. Elliott, knowing the sensation, takes him kindly by the hand, and seats him on a waggon for coal, and there he sits until the pupil of his eye is sufficiently adapted to the locality. At first you can see little or nothing, and it seems as if you were in total darkness. Then, in a minute or two, you distinguish the men at the shaft bottom, and the sluggish oil lamp, and the little lads coming up with their train of coal-waggons; then the horses, or ponies, being unfastened

from one load and conveyed inwards to draw another. Now you can see the remarkable smoothness of the horses' coats, and the sleekness of the ponies' appearance. The pit agrees admirably with the equine species, being of a rather warm temperature, and in the main ways, wherein they labour, tolerably equable and healthy. Pit-ponies, therefore, differ remarkably from pit-men and pit-boys. The horses get fat, the men lean; the ponies well-conditioned, and the lads ill-conditioned; the horses sleek and shining, the men skinny and pale; the ponies straight and erect, and the human beings half bent and half bowed in the legs. But we must not stop with the horses, or at their stables, which are well furnished, and apparently much delighted in by the equine tenants. Let me mention only, that the quadrupeds are conveyed down the pit in large nets, and with care are comfortably landed; of course, they do not get up again, but live night and day down in their subterranean stalls. Sometimes they receive the visits of a veterinary surgeon, and sometimes they are hospitalled in the pit.

Elliott, I, and Wriggleton, are ready for our subterranean journey. But I must put Ben between us, Elliott going first. The man at the bottom has put a piece of clay into each visiter's hand, between the first and second finger, and inserted a pit-candle in the clay, and away we go, carrying our lights with us. Elliott cries, "March!" and on we slowly march. While we pass along the main passages the march is not unpleasant, as we are able to walk erect, or nearly erect, in a tolerable underground street. A fair current of air passes with us, and we breathe comfortably. The first signs of pit labour are the passage of numerous trains of coal-waggons, small in size, but long in their trains; and these convey the produce of the interior workings of the mine to the bottom of the shaft. You see, sitting on the foremost waggon of the train, a lad, who is the driver of the horse or ponies that draw the whole. Iron railways, or "tram-plates," are laid down along the mainways, and the little driver has to act as train-engineer. Hark! he is singing a song, which I may thus present to you:—

When me and my marrows* get up to the light,
What a game of good fun will we play;
We'll sing all the day, and we'll sleep all the night—
O! who as the Driver so gay?

I sit on my seat, with my whip in my hand,
And I crack it so often and loud,
That the King on his throne, and the Lord of the land,
Are neither more happy nor proud.

If I fall from my seat, I meet with a "laming,"
But I get up again in a trice;
If I don't break my head, then it's nothing worth naming;
And I don't want the doctor's advice.

What a merry gay life is that of the Driver,
And what if I scarce see the sun,
I can sing in the dark, and spend my last stiver
In sweeties, and frolic, and fun.

Here I am on my seat, with my whip in my hand,
And I crack it so often and loud,
That the Queen on her throne, and the Lord of the land,
Are neither more happy nor proud!

"Gee up, Dobbin!—now, lazy Nancy." Crack! crack! crack! "Gee up—gee up!" all succeeded by shrill whistling. And now let us part with the driver so gay.

Here we seem to have come to a door, shut, and hindering our progress into the interior of this strange country. What can be the use of a solid, heavy door down here? Why, this is the first of the *ventilating doors*, put up to regulate the direction of the current of ventilating air, and these doors perform a most important part in this work, which you will understand by reference to my future remarks under "Ventilation." But what in the world have we got here? A little mite of a boy, sitting behind this door, crouched up in a corner, looking any thing but like a free, joyous boy of playful propensities! What can he be doing here? This is the little "*trapper boy*," the youngest piece of humanity employed in the mines: his duty is to pull open the door with this cord, whenever he hears the drivers or trains of coal waggons coming on one side or the

* Mates, or companions. *Marrow* is a well-known provincial term.

other. The door must only remain open long enough for the passage of the trains, and must then be closed again immediately, or the current of air would be diverted in its course. At present, the air-current is going with us, or we with it; but come through the door, and, now that it is closed, apply your ear to it—you hear a rushing, hissing sound; this is the air-current coursing up to the door, and meeting with the resistance of the door, and thus making itself heard. At the doors further in you may hear this sound again, and sometimes very loudly. When the current of air is very strong, or when the wind above is very high, you may hear the doors making a much louder noise, and in such a case the pitman will tell you that the "doors are a singing." Indeed, the singing of the doors is a kind of warning that the ventilation is somewhere deranged when the song is too loud.

As to the little trappers themselves, no persons in the pit so move our feelings and excite our interest. By the great exertions made by Lord Ashley, and the arduous labours of the gentlemen who reported on the Employment of Children in Coal-Mines, whose Reports were published in 1841-2, an Act of Parliament was obtained (5 and 6 Vict. c. 99), prohibiting the employment of any female in mines after March 1, 1843, and also the employment of any one under the age of ten years. No females were employed in the north; that indignity was only known in other districts; but trapper boys were employed at a very early age. I greatly commiserated these little fellows, and was anxious to discover their real ages as well as their real condition. To discover their ages, however, was no easy matter, for they themselves scarcely knew them, and it was not thought very desirable by any body that I should find them out. On one occasion I met, in the recesses of a pit, with a little boy who was certainly not above seven years of age, and who, from his diminutive appearance, might have passed for six years old. He told me his father was killed in an explosion, and that he was very much afraid, that if any accident should happen, he would never get out of the pit alive, "for," said he, "I go in very far bye (meaning far in), and it is very hot there." I also elicited

from him that he was down the pit at an explosion, which happened a year and a half ago—the same, I think, that killed his father: he described it as "coming like a heavy wind, and blowing all the candles out, and the small coal all about. It blew Richard Cooper (another trapper boy) down, and the door upon him." You may suppose that I looked on this little spared one with great interest. Let a happy mother imagine her little boy, of some six years of age, as versed in the history of a destructive pit explosion, and left fatherless by it. Ah! I suppose few mothers in their comfortable homes, with all needful appurtenances, have ever conceived that such things were happening in England—in "merry England!"—almost under their feet, and while they were warmed at their own fire-sides by the coal coming up from those very pits where children of six, seven, and eight years of age were daily immured for ten hours!

Another little fellow, William Bates, who was too small for any underground duty, and who seemed to be five or six years old—while he was described as seven or eight years old, at a guess—was keeping a door in another pit which I visited. He could neither read nor write, nor tell his age, nor could he in any way prove his human intelligence, though he declared he went to a Sunday-school. He had then been employed in the pit a year, though the manager assured me that he was unfit for a pit at that age. But the needy parents had besought his employment, knowing him to be a weakly child, simply because they would get the 10d. per day which trappers earn. Yes, happy mother! in your suburban villa, and comfortable nursery, 10d. a day was the price of that child's imprisonment! But I am thankful to my heart, and shall be through life, that it is now needless to say much on this matter. An Act of Parliament will prevent managers of mines from yielding to the entreaties of covetous and needy parents. I could, if desirable, add much more to move the feelings, but I abstain; not but what I think even ten years of age quite young enough for the duty of a trapper. You must remember that pitmen's boys of ten are more diminutive than your boys of ten. And this boy has to rise very early.

Suppose there are two or three "shifts," or sets of men working in the pit for twelve hours each set; the first set will probably go down the pit at about two in the morning (or night), and they will work eight hours; but the boys must go in with or soon after the men, and work twelve hours. If there are three shifts of men for the whole twenty-four hours (when the pit is at full work), then each shift or set will work eight hours; but there will only be two sets of boys to the three sets of men, and these boys must, therefore, work twelve hours each set, say from two in the morning to two in the afternoon, and the second set from two afternoon to two morning (or night). Whatever be the hour at which the men commence work, at that hour the boys must go down, and especially the trapper boys. But the men, particularly the hewers, may finish their work in six or eight hours; not so the boys, they must be ten or twelve hours in the pit for certain. Add to this, that the trappers—the doorkeepers—sit alone, at the back of their doors, and generally alone in gloom. If the parents should give their boys two candles (small pit candles) a day, they would be considered indulgent parents; but two candles will only serve to light the boys in and out of the pit.

Realize the fact of the boy sitting in the gloom ten hours, the greater part of the time by himself, and only comforted by the sudden shout or song of a team-driver approaching with his train of coal-waggons, and demanding the opening of the boy's door. Perhaps the boy keeps a putter's door, *i. e.*, one through which those boys pass who push along the coal-baskets on rolleys. If the doorkeeper does not open the door in time, or otherwise please them, they stop to bestow upon him a thump, and leave him a kick as a parting legacy. Again, the boy has, perhaps, heard of sundry hobgoblins in the pit, and the putters delight to add to his fears, and occasionally personate an imp of darkness, to the little fellow's unspeakable terror. Or he has known the effects of an explosion in this pit—has thereby lost a father, or a brother, and knows that another explosion may happen any minute. What then with unreal imps, and real explosions, and real thumps, and real darkness, and a real tardy ten or twelve

hours many hundred feet below ground—what with all these together meeting upon a boy ten years of age, I do not think all I have said, written, or done for the little trappers on various occasions, has been unnecessary. I shall never forget their short and simple annals, or their touching appeals to me, as I have passed them in the pits, in this wise,—"Maister, gie us a low" (a light or candle); "What o'clock is it, please, maister?" "Will it soon be time for *kenner?*" The word "kenner" refers to the shout of the banksman, who, when the hour of ceasing work arrives, calls down the shaft, "Kenner! kenner! kenner! oh, oh, oh!"

What do you think of the following boy's verses, written after a pit perambulation?—

THE TRAPPER'S PETITION.

Father! must I go down with you
Into that dark and dismal hole,
And leave the sky above so blue,
Buried amidst the blackest coal?

Father! I want to go to play,
I've had no play since Monday last;
O! let me have one hour to-day,
And then I'll work and do a vast!

O! let me play a pretty game
With Tom and Bill upon the heap,
And I shall do my work the same—
For then I shall not fall asleep.

Just let me get those pretty flowers
Down in the field beside the stream;
Then I shall wile away the hours
As though I lay in pleasant dream.

Why must I sit behind the door
So many hours away from you,
And hear the putters shout and roar,
And naught but shut and open do?

'Tis very dark, and that small low *
You gave me, soon will burn away;
And I'm afraid, and tremble now,
To think of biding there all day.

Low, a light or candle—the common word in the pits.

They never let me come and sail
My little ship upon the pool,
Or read that pretty little tale
My mother got me from the school.

But if I must go down beneath,
Don't let the putters beat me sore;
I tremble so, it stops my breath
To hear them coming to the door

Just come and see me now and then,
And bring me little bits of bait,*
Then I sha'n't tremble at the men,
And will all day in darkness wait

Well, father! if I must go down,
Just hold me tight upon your knee;
But get me work in yon big town,
And let me life and daylight see!

We now pass away from the little trapper-boy, and are also passing into lower galleries. The mainways through which we have come, vary in height from seven feet to five feet eight inches. The "bords" in which we now stand, are about five feet eight inches high, that being the thickness of the seam of coal. I, being a taller man than the galleries, must stoop a little; you need not stoop so much. The lowest working-place in this pit (allowing for "creeps" and the like) is, I find, three feet six inches. Into such places as these lasc, the best method of entering is, by lying flat on a rolley, and then being wheeled in by an experienced pitman. I have done this before now; and, while lying on my back, pleasingly surveyed the shattered roof. The air is now becoming hot and very oppressive—do you perspire? I do, and that is the relief. So soon as you are in a bath of this kind you feel easy, and can breathe readily.

Here we come to a new set and sore of lads and boys, who may be called generally "putters." This term signifies the boys who push, or put, the trains of coals from the places where the hew-

* "Bait," the common word for food, or pit-refreshment. "Bait-poke" is a bag of bait.

ers fill them, to the crane, where they are hoisted upon the rolleys, or waggons for transporting the coals from the crane to the shaft. A rolley holds two or three tubs, and is ten feet long if for three tubs, and if for two tubs, is seven feet six inches long. The roads along which these rolleys are driven, when loaded by the drivers, are the principal horse-roads, extending into distant parts of the mine; and they are made sufficiently high for an ordinary horse by cutting away the roof or the floor. Some of the rolley-ways are two miles long, and are kept in repair by a rolley-wayman. They are that part of the pit which more particularly belongs to the driver. We have now passed the end of one, and have arrived at the crane whereby the loads are hoisted. This crane is attended by a boy of from twelve to seventeen years of age, called a "craneman" or "crane-hoister." He earns from 1s. 6d. to 3s. a-day for managing the transference by the crane, and for "chalking on," or keeping an account of the number of baskets of coal craned by him. Where tubs are used for the conveyance of coals the whole way, no crane is necessary and no craneman, but a lad termed a "flatman," who links together the tubs at the level or the *flat*; he must also "chalk on" a smooth board the numbers of tubs. This is the only arithmetical art required in the pit.

But now, having passed the craneman or flatman, we are amidst a rough and roystering race of lads and boys, who seem but half civilized—they are the putters. Next to the hewers, they are the hardest labourers in the pit; and in some few places their labour is even harder. It was a long time before I became skilled in all the subdivisions of their labour, which are these:—The term "putter" includes the specific distinction of the "headsman," "half-marrow," and the "foal." Where full tubs or baskets are to be pushed along the rails from the hewers to the crane and the drivers, the headsmen take the chief part; a half-marrow goes at each end of the train alternately, with another half-marrow, while a foal always precedes the train. Where the inclination is steep, there are "helpers up" to assist at the worst. The foals and half-marrows often employ a pair of cords, called "soams," from two feet nine inches to three feet

in length, for pulling up the loads. Before you can converse satisfactorily with the pit lads, you must have all these technicalities at your fingers' ends. The average weight of the loaded corf or tub put by putters, is from six to eight hundred weight. The greatest is ten hundred weight. The putters are paid by the number of tubs put, and can often earn (the eldest of them) from 3s. to 3s. 6d. per day. The half-marrows will make from 1s. 6d. to 2s., and sometimes 3s. 6d. per day, and the foal about 1s. 6d. or 2s. per day. The gains depending upon the scores of tubs put, they will differ according to the strength of the boys; and I have found some boys making only 1s. 3d. per day. All these lads come into the pit an hour or so after the hewers, and then find baskets of coal ready filled for them. In this pit the putters put full tubs down a descent of one and a quarter inches to the yard as maximum fall, and down half an inch as the average fall. Notwithstanding the severity of this toil, it does not commonly injure the boys' health very materially, if they be naturally strong boys. Such boys feed well, and drink water in large draughts down the mine, where no beer or spirits are ever permitted. You see casks of water placed here for their benefit; and they probably thus repair the rapid waste of the bodily fluids by perspiration. They stop "to bait" at fixed times, and then devour huge hunches of bread and cheese, with a bone or so of meat, drinking at that time cold coffee or milk out of tin canteens. When at home after work, they eat as much as they can get; and they generally get fat meat, or bits of "singing hinnies," which are rich kneaded cakes, that sing with their exuding fat when baking on a girdle or gridiron. Some prefer cheese and bacon to other food; and it is a common remark, that pit people have always white bread of the best flour.

I suppose that in no pit is putting so exhausting as in this: for here the heat of the unbroken mine averages about 78° Fahrenheit. Mr. Elliott has known the extreme heat to be 89°, where animal heat has been added to the natural. He tells me that, at the bottom of the pit, the mercury ordinarily stands in the barometer at thirty-two inches, and that water boils here at 220 degrees Fahrenheit. A curious medical fact is, that by some means

boils are frequently produced in this pit. The putters are very subject to them at first. From the medical attendant at this colliery, I learn that, when a fresh man enters the mine to work, he is generally plagued with these boils, which may arise from the heat in the first instance, and become subsequently aggravated by the salt water found here. This salt water used to pour out from the dykes and troubles in large quantities in the early workings; and the water is exceedingly irritating, though not caustic. The great heat, too, affects the vessels and glands of the skin in new-comers; and therefore boils are found on parts of their persons which the salt water would not fall upon or reach to.

The hewers are generally afflicted with these boils or carbuncles at first, and after appearing in succession for a month or two they disappear, and wholly cease. The continued operation of such deleterious effects in this and other pits, produces some asthmatic affections, but not to the extent sometimes alleged; and, strange to say, this very pit from its warmth is quite an asylum for asthmatic people, according to the viewer's assertion. It evidently agrees, as I have said above, particularly well with horses and ponies, who appear sleek and contented in their subterranean stables. I was much amused, also, to find a fine cat comfortably domesticated in one pit, and provided with a plentiful game-ground, for the mines abound in rats and mice.

I have on different occasions, and in different pits, questioned a large number of lads engaged in the putting labours, but could not elicit from them very much more than a description of their present labours, their peculiar hardships (not always quite truly stated), and their past accidents. Taking in the class of drivers as well, it is at first quite strange to hear of the numerous accidents many of the boys have met with. This is alluded to by the driver in his stanzas, given above. These accidents are commonly called "lamings" by the boys; and I found that several of them had no other chronology than that formed by the occurrence of these disasters. Thus, while a Greek reckoned by Olympiads, a pit-boy reckons by limpings. "O," said one, in reply to my question about the date of a particular event—"O, I

don't know when, but it was just after last laming." "No," said another, "I never learned to read till last laming but one." "I," would another say, "was lamed twice in Howden pit, and once in Walbottle;" and a little lad of some fourteen years of age, would speak of having been "lamed three times while he was a driver, and once since he has been a half-marrow." Another had lost a finger in Felling Colliery, and broken his leg in Walker pit, and cut his face in Percy Main. These things they had suffered before they were perhaps eighteen years old, in any case, but the little hardy fellows soon recover, and go down to work again; and, if they are unacquainted with learning, they are well versed in laming.

In all upper-ground games and disgraces, the putters are found to be the most pugnacious of the pit folk. A headsman, or senior putter, will often be found a dangerous combatant, and that *vi et armis*.

A great improvement has, however, taken place both in their upper-ground behaviour and their under-ground labours. I met with a merchant at Newcastle who had himself known the severity of boyish labour in pits some forty or fifty years before. His description of that period was indeed sad, and it was very detailed. Then, according to his account, the boy would go into the pit to work at two o'clock on a Monday morning, and arrive at his home between eight and ten o'clock at night, entirely worn out. He would again repair to work the next morning at the same hour, half asleep, and sometimes half naked. This continued through the week, and he would not see much daylight from the Sunday until the next Saturday afternoon. Although this state of things might not be permanent as regarded the long hours, yet the labour was always extreme, and two boys were often bound to "put" together, without the adequate strength. Continued quarrels arose between unequally-matched boys, and though these were sometimes brothers, fights and foul language were frequent amongst them. One great cause of improvement was the employment of metal or iron plates for the trains to run upon, and another was the blasting of the coal with powder. Before this, the boys often had to drag their load over

a fir plank, or even the bare floor. Now the whole way is laid with metal plates, even up to the face of the workings, and by this improvement one lad can perform the previous work of two.

To quote a verse from a poem in the pit *patois*—

"But heavy puttin 's now forgotten,
Sic as we had i' former days,
Ower holly thill and dylls a-splittin'—
Trains now a' run on metal ways.

"Then bless the man wi' peace and plenty,
That first invented metal plates!
Draw out his years to five times twenty—
And fill his dishes and his plates."

Amongst the possible improvements of the putters' labour, is the introduction of Shetland ponies into mines. They would do the work well in many mines, but then this improvement would altogether exclude the putters from work; they would, therefore, do well to be quiet unless they can find work elsewhere.

It may have occurred to the reader, while amongst so many boys in the pit, to ask what proportion they commonly bear to the adults employed. The same question occurred to me, and to answer it I obtained, by favour, returns from the principal collieries on the Tyne and Wear (those north of the river Wear, and shipping exclusively by the Tyne). These returns were from forty-six collieries, thirty-one of which I myself visited. The sum total derived from the whole is as follows: The number of males aged above 18, employed in these collieries, amounts to 7261; the number of males, aged between 13 and 18 years was 1932; and the number under 13 years of age was 1349. The last item may be somewhat smaller in proportion at present. In this very pit which I am now perambulating, I find the number of males above 18, to be 135; the number between 13 and 18, to be 24; and the number under 13, to be 27. This is a smaller number than in older and more extensive pits. At Jarrow pit, for example, an old concern, I found the numbers to be, respectively, 230, 56, and 37; and at Manor-Wallsend they were 248, 73, and 40. At Seghill, a large concern, the numbers were, 319,

80, and 52. The returns included the persons employed at bank, or on the surface works of the mine.

I imagine one of the first questions an anxious mother would ask would be, "Is there not great danger of little boys of ten years of age being lost in the passages of the dark mine?" Formerly there was great danger of this kind, with very little boys under ten, or even eight years old. But, on the whole, very few cases of this kind have occurred in the northern pits. The trappers are stationary, and if found away from their doors are thumped and threatened. Many sit there, too, in fear of the hobgoblins to be met with in the pit; and the reputation of hobgoblins is sustained for their good behaviour. Some friend, if not the father, takes them to the door, and probably comes for them at "kenner" or "lose" time. As to the drivers and putters, they are in no danger of being lost, as they are in juvenile company, and know their own work-places.

Very recently a little boy was lost in one of the Welsh pits. His name was William Withers, and on a Friday morning he went to work with his father, as usual. On arriving at the pit, he found that he had forgotten his lamp, and returned for the purpose of getting it, intending to follow his father into the mine. As he, however, proceeded along the subterranean road, he lost his light, and as a consequence, his way, and wandered into some old works. From that time until Monday morning he was not seen or heard of. He was then found by the hauliers in a very weak state, and taken home. The poor boy had only his Friday's dinner in his bag, during the whole time. His own account is as follows:—"After I lost my light, I found that I was lost, and in a strange road. I could hear my father at work all day on Friday. I knocked the side, and made as much noise as I possibly could, but no one answered me. They all went out that night, leaving me there; I cried very much. I thought I saw the stars two or three times, although I was 100 yards under ground. I saved my dinner as much as I could, only eating a bit at a time, not knowing whether I should ever be found. The pit broke [work] on Saturday morning, so there was no work until Monday morning. The whole time I had

been wandering about in the dark, when I heard the hauliers, and I made my way to them." When asked what day it then was, the poor little fellow did not know, but thought he had been lost seven or eight days.*

I must now finish with the juveniles and adolescents, and proceed to the adults in the mine. In our further progress into the interior, we meet with returning overmen and deputies. These have descended the pit two hours or so before the working people, and a "caller" goes round the pit-village, calling them the first in his calling course. It is the business of these men to see that the pit is safe and right before work begins. The deputies inspect the wood-work, the traps, the air-sluices, and "brattices," all of which must be kept in perfect order, to preserve the ventilation and the clear way. If any thing is doubtful, the inspecting deputy flings a shovel, or pick, or prop across the part, as a warning to the incoming hewers. Perhaps they chalk a sign of warning on the back of a shovel, and stick the handle in the ground, leaving it there like the Humane Society's board, "Dangerous," in perilous ice. We have now arrived at the very *sanctum* of the pit, the place where the men hew the coal; and now for the hewers.

It has often been mentioned as a mysterious degradation of Egyptian idolatry, that the most majestic structures, of amazing length and most massive proportions, should have been erected as temples, in the innermost recesses of which you would find—as the apparent cause and end of all this architectural wonder—a contemptible crocodile, or a stupid ibis, or a lazy bull. Now, just as disproportionate as the crocodile, or the ibis, or the bull might seem to a vast Egyptian temple, so disproportionate does the hewer of coal seem at his work in the innermost recesses of the pit, to the enormous depth of shaft which you have descended, the long tortuous course of underground journey you have been taking, and the immense mass of stone and earth all around and above him and you. Yet, in fact, these few poor carbonized-looking men, in garments neither shapely nor sufficient according to upper ground notions—these poor, squatting, blackened, queer, begrimed beings, are the equivalents of the

* From the "Hereford Times," December, 1852.

crocodile, the ibis, or the bull in the Egyptian temple. The hewers are the key of the pit, the centre of the mining system. All arrangements below ground are made to suit them. This shaft of 1600 feet, and other shafts of 1000 or 1200 feet, are sunk that *they*, above all others, may get to their work. The great steam-engine is erected to pump out water that *they* in particular may be dry: the complex arrangements for ventilation are established that *they* may breathe good vital air. All the drivers and trappers, the putters and half-putters the ponies and waggons and cranes and crane-boys, and helpers-on, and overmen, and wastemen, and deputies, and lamp-keepers, all wait upon and depend upon these comparatively few hewers—squatting down, and bringing down coal "far in bye," and out of sight. They are like the political ministry of the country—the cabinet council—governing and directing and working for the whole pit population besides. But then *they* do not seem superior to the rest of the pit people—nay, rather inferior in appearance and health—while they do resemble the political ministry in this respect, that they get good wages! The work is indeed very hard work for the time it lasts, and in no pit in the whole district so hard as in this pit, because of the great heat and the consequent exhaustion after labour. But positively, when I was about to describe their troubles, one of them was singing! Let us try and catch the song for publication. Well, it is nearly as follows:—

Was there ever so slaving and slashing a trade—
Such a trade as this horrible hewing?
I wish I'd been bred to the plough or the spade,
To building, or baking, or brewing!

I'm up in the morning afore it is light,
And down in the pit in the dark;
And tho' I get home afore it is night,
I'm asleep from my terrible wark.*

'Tis I make the ladies and gentlemen warm,
Tho' I hav'n't no Lat'n nor learning;
Tho' I'get 'em their coals for winter and storm,
They don't think of me while they're burning.

* *Wark*—pit language for work.

I squat in the dark to give them their light,
And I hew while they are in slumber;
Tho' I don't think it rhyme, or reason, or right,
I shouldn't be one of their number.

Was there ever so slaving and slashing a trade,
Such a trade as this terrible hewing?
I wish I'd been born to the plough or the spade,
To building, or baking, or brewing!

Well, marrows,*—come, marrows—come, put in the pick,
And curve out the jud and the jenkin;†
The seam is so thin, and the air is so thick
That—*Maister your health should be drinking!*

You now observe the characteristics of these hewers, and their work of hewing the coal. This is the innermost workshop of the pit; into this place the hewers make their way at two or three in the morning, and here they work for eight hours, some one or two possibly a longer, and some few a shorter time, for they are paid by the amount of clear coals sent up. The pick and the spade are the hewers' only tools. You see one kneeling, another sitting, another stooping or bending double, and you may sometimes (especially in very thin seams) see them lying on one side, or on their backs—hammering at the coal before them or above them with their short and heavy picks. To hew coal well is a peculiar and difficult work. The men have been brought up to it, or brought into it, through the successive grades of trapping, teaming, and putting. Hewing is the topmost promotion—the colonelcy of the regiment. Gunpowder may be used to help the hewing, by tearing down or loosening the coal, where naked lights can be used with safety; and the hollow boom of the blasting sounds very singularly in the confined recesses of the pit, at first alarming one with the idea of an explosion of fire damp; but where Davy lamps must needs be employed, gunpowder must not.

The intensity of the hewer's toil is great—his confined position makes it worse. Where there are several props and stays

* *Marrows*—that is, companions, mates.
† *Jud* and *Jenkin*—technical terms in hewing coal.

to uphold the roof, he cannot well get his strength to bear on the coal-seam; and, if the seam be hard as well as thin, then you must witness his labour to know it at all. He is generally bathed in perspiration (though some practised ones are cool), and enveloped in coal-dust, and complaining of this "drouthy wark." If you wish to converse with him, and have learned the dialect, he will tell you all his hardships, and his master's hardness, with a glib tongue. The best hewers have learnt to do their work in quick time, and it is curious to watch them shifting their postures, and strangely adapting themselves to the exact form or figure required to bring down the coal with advantage and speed. I have never seen any labour like it; but its duration and voluntary extent must be measured against its intensity.

Close behind the hewers stand the tubs or baskets to be filled with coal, by the use of their spades. They will earn from 3s. to 3s. 6d. or 4s. per day; from this must be deducted the expense of powder, which they find if used, and the cost of their own candles, of which they will use a pound in a week, at 6d. per pound. The Davy lamp is not so expensive to burn, but it gives less light, and is less manageable. Each miner has, say, six picks, which the smith of the mine keeps in repair at his expense. All these little matters are important in the history of the mine, and frequently talked about. The hewers have house-room found them, as will be noticed in the description of their habitations. Formerly the hewers were hired by the year, by the terms of a Colliery Board, which I had to study minutely, as my brief, to understand their alleged grievances. They are now more frequently hired by the month, and hired to assist at any kind of labour requisite in the pit, whereas before they were only hired to hew coal. Their pit dress is made entirely of coarse flannel, and consists of a long jacket with large side-pockets, a waistcoat, a flannel shirt, a pair of short drawers, and a pair of stout trousers worn over them. Add to these a pair of "hoggers," or footless worsted stockings, a tight-fitting round leather cap, and you have the hewer ready for the pit. A pit suit costs about one pound, if purchased at the slop-shop; though some wives and

daughters can make them. But on Sunday the hewer is seen dressed in a suit of black cloth!

"Now, Wriggleton, queer as you look, my friend, you ought to remember, that you are privileged in no ordinary manner in being permitted to stand where you now stand. You are nearer to the centre of this rolling earth than you ever were before in your life, or ever will be again, unless in this same place. Much is thought of visiting the ruinous sites of renowned cities, where men can walk over wild wastes of solitary sand, and where, some centuries before, other men walked over smiling fields, or through long and populous streets, and by ship-bearing rivers, and all the marks of thriving commerce. The mind grows melancholy in conjuring up, upon the plain of now unprofitable sands, the once living multitude, the thronging idlers of the market-place, the vivid and impassioned orators of the forum and the senate—the meditative philosophers of the grove, the academy, and the schools—the long lines of vanished villas, and of gilded palaces, and all the triumphs of successful war—of thriving places, of monarchical splendour. Where now are all these things—all these men?—Nothing but tumbled stone and marble images, ruined and mutilated, now remaining—not a relique of profit—not a fruit of their lives—not a single heirloom of all their arts, and wars, and trades, and schools, come down to posterity! They are as though they had never lived upon this changeful earth. We cannot even till the fields, and fertilize the ground, with ought they have left—not even their bones remain to make manure. And their images and statues?—Well, a few half-broken ones may find their way to the Halls of London or Paris. But the men, the women, the children?—Not one useful result of their lives—their name, their deeds, their loves, their animosities—all gone out like the little flame of a taper! The bones of the mighty dead, indeed!

"But now, Wriggleton, you are really in the homes of the mighty dead! Don't start—no skulls or skeletons here—no ghosts or ghastly sights. Yes, I know you have been in catacombs, and have been in pyramids and Theban tombs; but, believe me, you are in the catacombs of Vegetable Giants! You are treading the streets of more than a buried city of men and monu-

ments. No storied arches are these—no marble busts are breathing a stony life here—no illegible inscriptions are standing and lying here—no mouldering bones, no shrivelled mummies, no Egyptian cats, no dried ibis—are here. No spoils of rapine, no relics of royalty, no fragments of luxurious appliances are here; and so you think you are in a place that lacks interest? You slow, melancholy, prosaic man! Why, all around you are the relics of innumerable forms of vegetation, which flourished and waved largely and luxuriantly in the warm breezes, long before Egypt was dreamt of, or Nineveh knew Nimrod, or Athens knew Theseus or Athene, or Rome knew Romulus, or—to begin aright—Adam knew Eden. Every tree and plant whose ruins are here compressed into these beds of coal, was ante-paradisaical—was green and was wood, centuries upon centuries before Eden had her first rose, and Eve her first walk amidst admired and admiring flowers! The great Pyramid of Ghizeh is nothing to this great pyramid of coal. Long, long before the first stone of that pyramid rose above the sand, these seams of coal were packed up close and compact, arranged and ready for human discovery and use. The Pharaohs were great men—but the Pembertons, the diggers of the deep Wearmouth shaft, are greater!

"And then, Benjamin, reflect upon the great fact, that the end of all this gigantic and accumulated life of vegetation has been to *our daily profit*. Yes, you could not now make any use of all the dead kings of Egypt, Greece, and Rome. If they had all been embalmed and mummified, *secundum artem*—you had been none the better for the possession of the entire mummified dynasties of Nabo-Polassar and Pharaoh-Neco: ay, and of Nimrod, and Semiramis, and Nebuchadnezzar, and Theseus, and Cecrops, and Romulus, and all the rest of our college friends. If in our halls at this moment, they would not be of one-half the use that one ton of Pembertons' best Wearmouth coal would be in your cellar at Wriggleton, or mine at Pitville. Empurpled emperors, away!—Sceptred and globed kings, away!—Lepidodendrons, Sigillaria, Pecopteris, come on! Reeds, ferns, palms, pines, trees and leaves of names yet unknown—ye are our friends!—This is your mighty catacomb! Ye are even now, after immemorial

ages, the warmest friends we have—fireside companions—domestic comforts—indispensable associates—friends in all seasons, and at all hours of day or night, waiting only a spark—friends in need, in winter—through life, up to the last hour of life—in prosperity and in adversity—in health and in sickness—in palaces and cottages—in peace and in war;—friends stored up for us ere we were born—friends before Adam became our forefather—before Eve became our mother—before——— Why, Wriggleton, what are you rubbing your head for?—knocked it against the roof, eh? Well, come along. Elliott, what are you laughing about?

"I was going to add, that not only have you the results of this primordial vegetation; but you have it in the most convenient, marvellously convenient manner. If man clears a forest, a primitive forest, in some far country whither he has by necessity emigrated, he has to proceed with tree after tree, and with each tree by blow after blow of his ringing axe,—how long will it take him to cut down one tree? Why, all that one blow can effect is one notch, and thus notch by notch he must cut his way to the heart of the trunk. Multiply the number of notches in each trunk by the number of trunks in the forest, and then what a work is there before poor feeble man! But there is no other way; and then the roots have to be grubbed up or tumbled over. Well, if one forest presents such difficulties to man now, what would have been the difficulties if man, ancestral man, had been bound to provide fuel in the shape of fire-wood for all his posterity? Clearly the work would have been superhuman, and man the most modern must now have been freezing away (I write in December) in a rapid approach to an icicle, or a deliquescent mummy. But observe the extraordinary beneficence of nature; she does not *cut* down, but causes forests to *decay*. Nature never had or has an axe; but water can macerate, and carry away, and heap up far more swiftly and securely than man. The problem given is this: to lay up the largest amount of fuel in the smallest space, and in the shortest time, and in the securest treasury. Now, where we stand, Wriggleton, these conditions are fulfilled, and the problem solved in the most masterly manner. Look at that seam of coal there; it is six inches thick. Now, in that thickness of six

inches, there lies the very essence of a whole forest of primeval times, the essence that can be useful as domestic fuel. If you had all the leaves, and trunks, and ferns, and mosses, and horse-tails, and other plants that went to make up that cubic foot of coal, put at your elbow, you could not burn them in the small bulk of your stove. But by maceration in water, by carbonization, and by bitumenization, you have all stored up in the smallest space, like the brains, the essence of the man, in somebody's skull. And this place is the securest treasury; for, until the Pembertons unlocked it, and they found it hard enough to turn the key, nobody could get access to it. Here it has been locked up for centuries after centuries, for thousands upon thousands of years, safe, not diminishing—sound, not decaying. You remember the fabled security of the Minotaur in the mythological labyrinth. Here it is realized in the Wearmouth coal-pit. Our German scholar, Creuzer, might add this in the appendix to his 'Symbolik.' Such things as coal-pits are the keys to mythology, and the sites of poetry. Parnassus is in Pembertons' mine!

"You are now in a bonded warehouse of fuel, or, if you like, in a bank of bituminous bullion. This bituminous bullion will soon be converted into currency of one ton, one chaldron, or one hundred-weight, to come within the reach of all purses, and the bank will not fail for many many years yet, however hard the run upon it—the harder the run, the more the managers will be pleased. If you stood in the cellar of the Bank of England, you would not behold so much bullion; if you stood on the pyramid of Ghizeh, you would not see so early antiquity; if you had a thousand of Chubbs' unpickable locks, and no American Hobbs to pick them, you would not have more security. Coal is in itself, in a mine like this, the climax of antiquity, security, compression, and inflammability!"

Well, it is time to wend our way back to the shaft. It is more pleasant to be meeting the incoming air here. Now we are in the main-way. We had better not delay longer, for this pit is exhausting. To go back does not seem so long as coming in did. Here then we are, at last, at the bottom of the shaft. Now, get in the tub. How much cooler it is here! Yes, you

feel a stream of cold air on your shoulders—that is in consequence of the ascent. Here we are at the top—the bank. What is the banksman singing there? Listen!

Ho! gently there, here comes the men
Whom I three hours ago sent down;
Here's Maister P. and Maister Ben,
Who gave the hewers half-a-crown.

Ho! gently there, for Maister P.
Is always working for our good;
And though he won't believe a lee,*
He'll make our hardships understood.

We like him much—there's ne'er a man
As ever talk'd with we so well;
He goes where'er a gemman can,
And hears what all have got to tell.

I like him vast, he's very canny,
And hasn't got a bit of pride;
I see'd him kiss our little Nanny,
And call our Bobby to his side.

My Missus says she do suppose
He's some great lord in this disguise,
'Cause every man and thing he knows,
And nothing fills him with surprise.

I do believe he'll tell our Queen
And Maister Albert all about it—
He'll tell 'em both what he has seen,
And so as they can never doubt it.

He's got a feeling heart and head,
As any gemman in our town;
He says he cannot sleep a' bed
When many pits he has been down.

He says he dreams of men a-hewing,
And squatting down like nigger slaves,
And all their work in darkness doing,
Right from their cradles to their graves.

* *Lee*—pit pronunciation of lie—alludes to the attempts of pitmen to mystify strangers.

He says he fancies pits a-firing,
And thinks he sees the men a-killing;—
But here he comes—black and perspiring—
I hope he'll tip at least a shilling!

Here we are at the cottage. Now for soap and water. First look in the glass one moment. That image! One glance is more than enough. Let us wash thoroughly and quickly. They have kindly provided warm water. Are you washed and ready? Let us go to the hotel. Put on your great-coat. It feels very cold now. Never mind, you will not see such another sight *under* this earth. I do not want any thanks. I am gratified by your gratification. I have kept you underground a long time while talking; but I thought it the best place to explain all matters to you. Far more interest is felt in pit matters while in the pit, than at the fireside. I only wish I had many other of my friends with me in this subterranean expedition.

BRUCE, THE TRAVELLER, UNDERGROUND.

A very amusing circumstance is that of Bruce the great traveller's descent into a coal-pit. When he returned from his many years' absence in Barbary and Abyssinia to his country mansion on the carse of Falkirk, in Scotland, he was greatly dissatisfied with the way in which his collieries had been wrought. After some stormy disputes with the individuals who had leased them, he agreed to submit the matter to a committee of experienced coal engineers, who accordingly met at Kinnaird (Bruce's mansion), inspected the mines, and made every endeavour to form an impartial judgment.

Conversing one day with these gentlemen, he challenged something which one of them said respecting the condition of the mines; whereupon the engineer said, if he was not afraid he (Mr. Bruce) might go down and satisfy himself on the point by personal investigation. The word "afraid" startled the ear of the traveller, whose commanding figure and bold demeanour had been the chief means of bringing him unscathed through so many

dangers. "Afraid!" said he in his magnificent way, "Sir, do you think I should be *afraid* to go down into my own mines?" At once he engaged to go down with them the next day, and they as eagerly took him at his word, secretly determined to punish him a little for the unreasonable way in which he had disputed many of their statements. "He speaks of Nubian sands," quoth one to another in private that evening; "we'll show him something worse to-morrow, if I am not mistaken."

Next day, accordingly, the illustrious traveller appeared at the mouth of the pit, and after investing his dignified person in the coarse clothes proper to the time and place, down he went with his *corps* of engineers. The strata in that pit were not very thick at the best, and many of the *wastes* were considerably crushed and fallen in. Walking, therefore, through Mr. Bruce's pits, was any thing but pleasant walking; nevertheless, as the engineers had secretly concerted, in they went, up one waste and down another, leading the unfortunate Abyssinian adventurer such a dance as traveller never danced before, either on the surface or beneath it, except the present author himself, when one mischievous viewer resolved to sicken him of a mine. All the while the engineers pretended to demonstrate to Bruce the conclusions at which they had arrived, not, however, allowing him to arrive at the conclusion of the mine. Sometimes the party would be stooping in a rectangular shape. Sometimes they would be wading up to the knees in wet coal mud; sometimes, also in deep mud, they would be reduced to crawling on their hands and knees for a quarter of a mile together. At one place the engineers passed through an aperture barely wide enough for themselves, who were men of moderate size, and evidently cruelly narrow for Bruce, who was the reverse. When they had passed, they exclaimed that they were afraid it would be very difficult for him to get through; but he was too proud to own himself defeated, so he tried the passage and fairly stuck in it. They had to pull him out by the head and shoulders, and a sore pull it was.

Thus they led him about, he evidently ready to sink down with fatigue, dust, and disgust, but stifling every word of complaint; and they, of course, greatly enjoying his distress, till to-

wards dinner-time, when at length they brought him back to the bottom of the pit, the only place where he could fairly stand upright.

The figure which he now cut—one tall mass of black mud and rags—is not to be described. Nevertheless, up to the last moment he appeared to maintain his usual composure, and the only remark he ever made implying his feeling was, that he did not think the wastes had been so dirty. It may be supposed that the next day he was much more docile on mining subjects, and ready to admit the conclusions of his engineers without another trip underground.

A capital subject for a plate in his quarto volumes of travels would have been—Bruce, the traveller, on his return from the mine! Doubtless he would have preferred any desert ride or walk in Abyssinia or Barbary, to another walk in such company and in such a place.

TEMPERATURE OF MINES.

Careful experiments have been made to ascertain whether there is any definite law, as to increase of temperature, as we descend in the earth. Some results of these experiments are as follow:—In a mine at Newcastle, at 280 yards below the surface, with a mean temperature of 47½°, the thermometer stood at 64°, being very near the augmentation of a degree for every fifteen yards, which proportion may be taken as the average in a determinate ratio. In another Newcastle pit, 538 yards deep, or about 3-10ths of a mile, where the temperature above averaged 47½°, that below was 72°; and in two other observations, 74½ and 78°. Numerous other experiments of a like kind have been made, and confirm this theory of an additional degree of heat for every fifteen yards.

The subterranean temperature is taken either from the heat of the coal, or the air, or a constant subterranean spring of water. Where there is no water of the kind required, wells or bore-holes are sunk to a lower stratum.

In past examinations too many experiments have been made

on the *air* of the mine, which for many reasons, besides miners' lights and chemical actions, is unlikely to yield accurate ratios. The following results, however, are more likely to be accurate evidences of the heat.

	DEGREES.
WHITEHAVEN.—Spring at surface	49
„ at 480 feet	60
Ratio from surface, one degree for 44 feet.	
WORKINGTON.—Spring at surface	48
„ at 504 feet	60
Ratio from surface, one degree for 42 feet.	
PERCY-MAIN COLLIERY (Tyne).—Mean temperature at surface	49*
mean temperature at 900 feet depth	70
Ratio from surface, one degree for 43 feet.	
JARROW COLLIERY (Tyne).—Surface assumed	49.5
Water at 882 feet	68
Ratio from surface, one degree for 48 feet.	
KILLINGWORTH COLLIERY (Tyne).—Surface assumed	48
Water, at 1200 feet depth	74
Ratio from surface, one degree for 46 feet.	

The near accordance of these results is remarkable, and a collateral proof of their accuracy. Strictly speaking, all the ratios require a small correction for the depth of variable heat.

NIGHT-WORK AT THE PIT. A NIGHT SCENE.

It is all night-work in the pit, even in broad daytime outside of it, so that all the underground labours might be called nocturnal. But a miner who works underground in the daytime, has the satisfaction of knowing that he shall soon see the light again, and ascend to behold its cheering beams; while he who works below in the night-time, only has the prospect of "revisiting the pale glimpses of the moon," and of walking home after work in gloom and silence. Hence to be put in the "*night-*

* Found to be really under 48 degrees.

shift" (by which not an article of dress, but an arrangement of time is meant), is always looked upon as somewhat of a hardship by the men. Pits must be worked on some occasions night and day; and this is managed by one set of men working the "*day-shift*," and another set the "*night-shift*." By a change of the sets of men, the night-work is fairly distributed amongst them all.

The difference of things on the surface in night-work, I will attempt to describe, from my recollection of a visit to a colliery near the Tyne, which was in full work, with large orders requiring night and day industry. Let the reader boldly accompany me, since we shall not go down the pit.

We start from a neighbouring house, in order to be at the pit's mouth about the time the night-shift men are going down. As soon as we get out of doors, we can see light enough from the colliery to direct our steps to it. What a beautiful starlight night it is, and how clearly you discern the skies from this open and unsmoked space! If you will come with me up this eminence, you will get a view of colliers loading coals by night down the river. See how deeply that flaming grating of coals is reflected in the water. There the rippling waves make the flame to vibrate in reflection; and what a beautiful blush of fiery redness is that on the water, when contrasted with the thick blackness lying upon the river all around! By the light of that glare, from the grating of burning coals which is suspended apparently just over the ship that is being loaded, you see the masts of neighbouring vessels just rising straight out of the gloom, and the rigging grows stiffer in its rigidity when seen before the night-lights. You might fancy the vessel itself was burning, and that those discordant cries that reach the ear were cries of distress from a terrified crew. But, no; they are the cheering cries of labour—"Oh! oh! oh! Pully, hoigh!—Pully, hoigh." You hear the noise of the machinery of the staiths, as the loaded waggons run on to the machine, are lowered down the trap, and then discharge their contents into the hold of the vessel. That "click, clack," is just the re-arrangement for the ascending empty waggon; and that dark circle appearing to sweep itself in the air, is the return of

the staith machinery in its ascent with the man who directs the discharge of the waggon.

The glare of the burning coals puts out the reflection of the stars in the river, or makes it difficult to discover their faint blue images, dazzled as we are with the brightness of an earthly fire.

But we must not linger near the river; come down, let us go to the pit. Now you see, as we come near it, how the narrow path is rendered visible by the flames of the pit fires. You ask what those numerous fires are. Well, now, we are nearly at the pit's mouth; you see those five large baskets of strong iron filled with burning coals, and suspended round the approaches to the pit. The entrance of the pit is about the centre round which those baskets of fire are hung. There, you won't often see a more picturesque affair of a night than this, in any commercial scenery. Yes, you must shade your face as you come near this coal-basket. It glares fiercely enough to blind you. Put your pitman's flap-hat over your eyes a few minutes. Now, we are inside the fiery circle. We seem to be in a charmed circle, like the magicians who are fabled to stand in fiery rings safe from all evil spirits outside of the ring. Ah! talk of spirits, and they will appear. So you might almost think—for what are those dark figures of human shape just emerging from the surrounding darkness, and approaching the circle of the fire-baskets? They seem as black as any spirit of doubtful origin; they are black from head to foot—shall I say to cloven foot? They are queerly enveloped in dusky garments; they carry some dark things in their hands; can those things be evil weapons of mischief? They grow more numerous. There are at least two, three, four, five, six, seven, eight, nine, ten, eleven, twelve, thirteen, fourteen beings! See, two or three have come within glare of the fire-grate. They *are* black—how dreadful! Well, they cannot pass the fiery circumference. Oh, yes! they can—they are coming, all of them, easily, boldly—the whole fourteen making way to us, fixing their glaring eyes upon us. Ah! who—what are those strange unearthly beings? Mercy on us—will no one say?—who—what?—those strange beings are the NIGHT-SHIFT MEN!

"Well, David, how are you to-night—and you, Robert and Harry?"

"Ah, Maister P——, is that you, Maister? What brings ye out so late o'night?"

"Well, my friend here wanted to see the pit-mouth at night work."

"Not much of a sight for any gentleman as has got a comfortable parlour—eh, Maister P——?—I'm a thinking. I wish I'se had a nice spick and span new little cottage and parlour of my own property, for my Nanny and my bairns."

"Well, David, so you will have, I hope, soon, if you work hard."

"Nay, nay, Maister P——, our maisters won't give us enough wages. I'se wish you would just speak to our Queen about 'em. I'se wish you'd only tell she and Prince Albert to come down here, and look at we poor slaves a-working here in the night, hundreds of yards under ground, while our maisters be a lying snug in bed, tucked up, and dished up with blankets and curtains, and twa or three glasses o' toddy afore bedtime——" (Approving laughter from the night-shift men.) "Never mind, my lads, I'm afraid the Queen wouldn't listen to me. Then what's the use of having 'are a Queen, Maister P——? And what's the use of the big-wigs, and members of parliament? I do think they ben't no use to any body but 'emselves and the bishops."

"Now, don't say any thing disrespectful, Harry and Davy, of our rightful and worthy authorities. You know I have explained all this five or six times to you already."

"Yes—yes, you have, Maister, 'cause you wants to keep 'em up. I dare say you got some kith or kin amongst 'em. But, I tell you what, Maister P——, it's my opinion that the price of coals will never rise until them lumbering big-wigs, and them Pusey chaps as wears nightgowns in church, is sent adrift. How can people afford a fair price for coals, and to hewers of coal, while they got to pay sic a lot of thousands a year for keeping up muffs and mummery?"

"Come—come, my lads, don't let us say any more on these matters. *Hark!* there's the banksman calling you. Ready—ready!"

"Well, Maister P——, be you a coming down pit to-night? Maybe with that gemman?"

"No—no, my boys, not to-night. Good-night—good-night, to you all."

See, now, those fellows are getting into the cage, and bending double to cram in as many as they can. How singular they look, cramped up in that iron cage, with their bags of food and their Davy-lamps! There, they are going down; look, look—they are gone, and all is dark and dull again at that pit's mouth. Let us get out of this circle of blazing coals. I see your cheeks are nearly red-hot. My eyes are full of that flying coal dust, and my mouth is rather bituminous in taste. Hark, how those sheds do rattle in the wind! Look here—a row of lights for the screeners to work at the screens by night. What a busy scene for midnight! All bustle and blaze and blackness here; and instantly, when out of the fiery glare, and away from the rattling noises, all stillness and starlight. Beautiful stars! you are never disturbed by man's business. You never shine brighter or dimmer for his pleasures. You do not heed "paling your ineffectual fires" before his blazing coal-baskets; and you do not lessen your light when he depends on you alone—serene, shining, heavenly, sinless, virgin-like, glorious—stars! Wriggleton—I wonder if there is any coal in Venus and Jupiter? Are there any coal-mines there? Is there a Newcastle in Venus, or a Durham in Jupiter? Here we are at the "Duke of Northumberland's." I suppose the waiter is sitting up for us.

NUMBERS, AND THEIR DEPENDENTS, EMPLOYED IN THE COLLIERIES.

The various estimates of the number of persons dependent on mining the Newcastle coal, made at different times, may be thus briefly presented.

In 1792, Dr. M'Nab estimated the number of persons employed above and below ground, including their families, at 64,725. In 1828-9, a parliamentary report gives the number

(exclusive of families, but including boatmen and seamen employed in shipping and carrying the coals,) as 45,500.

In 1841, it was communicated to the government, by a deputation of coal-owners, that the capital embarked in the different branches of the northern coal trade, amounted to £9,500,000; and that there were employed 33,000 men and boys, and no less than 6873 ships, whose tonnage was 978,065 tons.

In 1844, the coal-owners stated, that in the 124 collieries of this district, there were employed 8607 workmen above ground, and no less than 25,383 below ground. Total, 33,990.

In 1847, it was said that the Newcastle district gave employment to 40,000 persons, of which number, however, only 10,000 were stated to be working under ground. It should, however, be noticed, that the year 1846 was one of great depression and competition in the northern coal trade, which is, indeed, always subject to great fluctuation. In that year it was announced, that the best Wallsend coals were sold at the pits of production as low as 20s. 6d. per Newcastle chaldron of 53 cwt., equal to 7s. 9d. per ton, free on shipboard.

We may now give an abstract of another view of these numbers. It is entitled, an estimate of the persons engaged in the export and shipping coal trade of Durham and Northumberland, and depending upon it for their support.

Employed in the Mines.—5500 men, 1400 boys over ten years old; dependent on these for their subsistence, 2800 women, and 1600 children under ten years of age. Total, 11,300.

Employed in the Transport of Coals.—(9132 cargoes in 1840,) in British vessels, averaging 220 tons each, besides those of the foreign shipping, 4200 seamen, and 1400 boys; dependent on these for support, at least 1900 women, and 1900 children. Total, 9400. Grand total (besides those indirectly connected with the mines and the trade,) 20,700. This estimate was published in a journal, and I think it very inadequate, and can only square it with others by conceiving it to apply exclusively to the Tyne river and its collieries, for which it may stand.

In 1830, an eminent coal-viewer of the north, Mr. Buddle, made an estimate, of which the following is an abstract:—

Working population of the mines, 21,000; workmen, as keelmen, &c., transporting and loading the coal, 2000; sailors, &c., in the coal shipping (with 1400 vessels,) 15,000. Total (exclusive of the women and children dependent on these for support,) 38,000 workers in the north. Add for the total London agency employed, 7500. Grand total for all departments, 45,500.

Mr. Buddle also gave the following detailed view as to the collieries themselves :—

EMPLOYED IN THE TYNE COLLIERIES.

I.—UNDER GROUND.

Men	4937	
Boys	3554	
		8491

II.—ABOVE GROUND.

Men	2745	
Boys	718	
		3463

EMPLOYED IN THE WEAR COLLIERIES.

Above and under ground	9000
Total	20,954

ANALYSIS OF A GREAT COLLIERY ESTABLISHMENT—SOUTH HETTON.

The establishments maintained at collieries must vary precisely in accordance with their capabilities and their efficiency. In order to exemplify an establishment on the largest scale, we take that of South Hetton, near Durham. It is not only one of the largest, but one of the newest, and is an example of most rapid growth. Some five years before it was commenced, the locality was a barren spot of ground, from which the nearest habitation was two miles distant. Now it is covered with buildings—a colliery village of new houses for miners, and a population of 2000 persons, who are exclusively connected with the colliery. You see also a gentleman's house—that of the chief viewer, and a good

school-room opposite. I here append a complete list of this mining establishment, which will afford a good idea, not only of the number of persons employed in each occupation, but also of the distribution of labour in this branch of industry.

LIST OF MINING MEN AND LADS AT SOUTH HETTON COLLIERY.

SUPERIOR OFFICERS.

	Number.
Manager	1
Viewer (chief mining superintendent)	1
Under Viewer (Mostly engaged under ground.)	1
Overman and Wasteman	2
First Engineer and Second Engineer	2
Surgeon	1
Clerks	4

WORKMEN CHIEFLY ABOVE PIT.

Joiners and Sawyers (to keep the works in repair)	13
Engine Wrights (to repair or make machinery)	7
Enginemen (to keep machinery in motion, and clean it, &c.)	8
Firemen (to attend to the boilers, fires, coals, &c.)	9
Smiths (to prepare the iron-work in rough)	18
Masons (to build engine-houses, &c.)	8
Labourers (to masons, &c.)	6
Cartmen (carting all work, &c.)	11
Horsemen	9
Saddler	1
Waggon-wrights (to lay down and mend rails on railways, &c.)	6
Waggon-riders (conducting trains of waggons, one per train)	11
Staithmen (to attend on the staith, or shipping-place of coals)	4
Banksmen (to work at bank or pit-mouth, delivering coals)	8
Screeners of coal, and waggon-fillers	12
Wailers (boys who pick out stones and slates from the coal)	9
Corvers, or basket-makers	4
Heap-keeper (looks to quality of the cleaned coals)	1
Storekeeper (over a vast quantity of stores for all the men)	1
Attendants on railway (includes engineers and furnace-men)	8
Trimmers (to fill the holds of vessels with coal from staiths)	8
Boys, for sundry miscellaneous duties	39
Total above pit	212

WORKMEN IN THE PIT.

Hewers (to hew down, blast, and get the coal)	140
Putters (to "put" or push coals in trains, with many assistants of different styles and ages, classed in one)	140
Deputies or foremen, ventilators, shifters, and several miscellaneous subordinate officers below ground	36
Total below ground	316
Add, Total above ground	212
Total of Colliery Establishment.....(Persons)...	528

It may be that few persons have previously conceived of the magnitude of a first-rate northern colliery establishment. It resembles a little community in itself. Men of all occupations, educations, arts, grades, and duties, and males of almost all ages, from ten years, are here; men, too, of all appearances, from the gentlemanly viewer to the doubtful wasteman; from the underground workers in chief, the hewers, to the humble "putters, foals, and half-marrows." You will find more of all sorts and sizes in a colliery concern than in, perhaps, any other establishment of a commercial character. Hence it was that I never found a day at a colliery of any magnitude, hang heavy upon my hands. There was always a great variety of operations going forward. I could ramble through the raff-yard; then step into the engine-houses, and gaze from the gallery on the polished and plunging engines; then I could glance at the boiler-houses, and question the engineers; then I could step to the pit's-mouth, the "bank," as it is called, and listen to the banksman calling occasionally down the shaft, and being answered as if from the innermost places of the earth. Anon I could scrutinize a gang of hewers coming up the pit, two by two, or three by six, or any how as the rope brought them; and then I turned, and looked upon some half a dozen other hewers coming towards the pit to succeed the ascendants. Again, I could turn round and gaze at the men who were emptying the coal corves or baskets as they came up, the waggons conveying these coals, and then the gang of boys "wailing" the rough coals, and discarding the stones and

slates. After this, I would take a look at the long line of sheds, under which were erected the screens, which were so many large, equally-inclined sieves, or grated boxes. Down these, men were pouring whole tons of coals, and the process of screening would proceed rapidly, until all the small coal went underneath, and the large marketable coal fell into adjacent waggons. The screens at some collieries were very large, and looked rather grand. When the corf, or basket of coal, is received by the banksman from the pit, it is conveyed, either by a train, or a new suspending apparatus, to one of a series of trap-doors in the bank-floor, through which the coal is teemed, so that it reaches the screen below. All coal which passes over a sieve, whose meshes are five-eighths of an inch asunder, without falling through, is called "Wallsend coal."* Now, people think that "Wallsend coal" comes from Wallsend colliery. Innocent folk! The Wallsend pits are but small concerns, and the name is now the largest part of them. But "Wallsend", being a fashionable name, it is convenient to apply it to the *size* of all coal, instead of the *place* whence it comes. The same coal, when teemed over a three-eighth screen, is vended as "Second coal," and sold to the shipowner at about four shillings per Newcastle chaldron less than the best Wallsend. A third sort, called "Nuts," is obtained from those which have fallen through the screen in getting the Wallsend and Seconds; and a fourth, termed the "dead small," is procured from that which falls through in the preparation of the "nuts." Thus the whole process of screening consists in making coal

"Small by degrees, and beautifully less!"

The screened coal is collected on a wooden stage, and shovelled into the waggons ranged in rows underneath, and which are made each to contain exactly 53 cwt. The best coal for domestic consumption is the worst for a blacksmith or a founder. And I

* At Hetton Great Colliery the screens were three-eighths of an inch asunder, varying at different screens from five-eighths to one-fourth of an inch. Formerly, from one-third to one-fourth of the quantity of coals drawn were screened into small coals.

may remark, that it sometimes happens that the produce of a pit containing inferior coal, is selling in the market for a higher price than the best coal, in consequence of an increase in the demand for that coal required for manufacturing purposes.

There is, then, a good deal of information to be got out of this screening process, provided the wind does not blow the dust in the spectator's eyes. I never could gaze long without getting as much dust in my eyes as knowledge in my head.

RATE OF SALARIES, WAGES, AND EARNINGS.

I have, in passing, mentioned the average earnings or wages of each class of labourers; but, on so interesting a matter, a few lines embracing a general view may be desirable. The viewer or chief manager of the mine has always a liberal salary, generally fixed at so much per annum, together with a viewer's local residence, and some perquisites. If he is a well-known viewer, he may obtain the oversight of two or more collieries, and will then be in receipt of a large income. The amount entirely depends on his celebrity. The oldest and chief viewers are gentlemen of education, and sometimes wealthy. I can testify to their hospitality and kindness, with very few exceptions, and to their readiness to afford information. Much of my minuter information comes from them and their subordinates.

The under-viewer is a younger and less experienced man; but much depends on him, as is seen in my account of the discipline of the mine.

The overmen will earn from 25s. to 32s. per week; their assistants from 22s. to 25s. per week. The deputies earn from 3s. 4d. to 3s. 9d. per day. The principal wasteman is paid 20s. to 30s. per week, and the ordinary one 16s. to 19s.

We then come down to shifters and rolley-way men, earning 2s. 6d. to 3s. 4d. per day. Of the hewers I have spoken at length as to their earnings. I found them at Hetton collieries to be 3s. 9d. per day. Their complaints are so loud and frequent, that I here add that it was once proved that, of men who complained, many averaged 3s. 10d. per day, and an average of the whole at

that very time gave 4s. each per day. This for six hours' labour is not so extremely bad. I could name instances of their earning 3s. 11d., and 4s., and 4s. 6d. per day.

The putters are paid by a minute scale. At Killingworth, I found the average to be as follows (for piece work): trams, 2s. 6d. per day; headsmen, 2s. 2d.; half-marrows, 1s. 10d.; and foals, 1s. 6d. per day. The drivers of the rolleys there get 1s. 3d., and the trappers 10d. per day.

Horse-keepers underground earn 14s. per week; furnace-men, 12s. to 14s. per week; banksmen (at surface, or pit's mouth) earn 4s. per day. Men in the engineering and manufacturing department, as engine wrights, earn 3s. to 3s. 4d. per day. Common blacksmiths get 17s. to 21s. per week. Common wrights, 16s. to 19s. per week. Masons, 17s. to 29s. per week, and waggonmen will earn from 2s. 6d. to 3s. per day. Such is a tolerably complete, and carefully gathered view of the earnings of most of the people concerned in pit work.

DISCIPLINE AND DUTIES IN THE MINE.

A good plan of the works, with adequate ventilating power, will not insure safety in a colliery, unless there be a vigilant administration of all the mining affairs, united with due subordination of authority, constant inspection, and effective discipline. It is not too much to say, that the daily work of a colliery should be conducted on the supposition that danger is always to be looked for, and always to be provided against. It is necessary to suppose that extraordinary circumstances may arise to baffle the prudent, and that error or folly may create danger out of ordinary daily occurrences. Accidents must in the first instance be guarded against, and prevented, if possible; but if they should occur, the means of lessening their calamitous effect should have been previously provided, and thus be immediately at hand.

The great Newcastle mines may be said to be established upon a system of effective and excellent discipline. Their present discipline has been arrived at by degrees, and may be said to be much improved within a few years. You now find few collieries

without regular maps, showing the extent and progress of the workings, the courses of the air, and the lines of dislocation in the strata. The scale of these maps, or plans, is commonly two chains to one inch. Sections are generally formed, and sometimes adorn the office walls. Large drawings, often very well executed, of furnaces, shafts, and engineering arrangements—measures of the air currents—notes of the consumption of coal in engine fires, and furnace fires—records of the temperature of the mine, of the upcast and the downcast shafts, together with memoranda of remarkable eruptions of gas, feeders of water, and other matters of mining interest—are now frequently under keeping of the manager at the collieries. These he will submit to your inspection, if you are on friendly terms with him, or if he thinks your object in desiring them commendable.

The actual condition of the mine may at any minute be known to the resident viewer, or the consulting viewer. The resident viewer is supposed to be, and very generally is, familiar, by daily visits, with every part of the works, and he is personally acquainted with all the workmen, having a word or two of recognition for each, as—"Well, Geordie, how is the air this morning?" or, "Come, Harry, go in bye, my man!" A practice is now prevailing, of making the most eminent viewers in the district consulting viewers; therefore the highest authorities of two or three principal or lesser mines, which they visit periodically.

The under-viewer has the general charge of the mining operations. He is expected to examine the mine every day; and, in addition to his own personal inspection of the workings—the waste, the state of the air-courses, and the quantity of air passing in the different currents, the ventilation, and the state of the mine generally—he is to receive a daily report from the overmen and master wastemen, on the workings and operations under their charge. As the result of his own observations, and of the reports made to him, he is to take measures for correcting irregularities, and for obviating all discoverable sources of danger. The viewer is his superior, to whom he must from time to time, and instantly in all cases of emergency, make reports.

The overmen have the charge of the working of the pit, and

more especially of the safety of the men—whence they are called overmen. They are assisted by deputy overmen, who are called in one word deputies. Their first duty is to go into the pit every morning, one hour before the hewers, to examine every working place in the pit, and especially to ascertain that it is in a safe working condition. They then return to the cabin (underground,) examine all safety lamps, and lock them, so that the men cannot tamper with them. No hewer is allowed to enter his working place until it has been examined by the deputy overmen stationed at his district. During the whole time the hewers are at work, there is at least one deputy in each *shift* (set or change of men,) at every district of the mine.

The deputy overmen lay the tramways, secure the workings by timber, &c., see to the doors and brattices, and keep the working places right.

The overmen attend to the lighting of the pit, inspect the lamps, direct whatever candles or lamps shall be used in exploring drifts, or while working, and see that lamps are always used in pillar-working.

The master wasteman, with his assistants, travels daily in the waste, or old workings of the pit—sees that the air-courses are every where in good order—remedies falls of the roof—builds or props up where necessary—removes impediments to the movements of the air, and generally attends to the precautions of good ventilation. Two wastemen, travelling together, go over the whole of the waste at least once a week.

To a certain extent, the men employed in the pits are expected to assist in these arrangements, by judging of their own safety, and accordingly they are forward to complain of bad air, or of insufficient timbering. In case of a strong impression of danger, they are said to be permitted to demand a professional inspection by some one not on the colliery establishment. If, while he is working, danger come upon a man, he is expected to retire, and to give notice to the officer in charge of his portion of the pit. The men generally take home the tops of their lamps, clean the gauze, and bring it back to be screwed to the oil cistern, and locked at the pit-cabin.

Fines are imposed for mismanaging the lamp, smoking tobacco underground, taking candles beyond stations, and the like. The amount of fines is applied at discretion for rewards, and for poor families of workmen.

Should any working-place in the mine become suddenly foul, and dangerous to work in with a naked candle, the hewer must retire, inform the officer in charge, and, if allowed, resume his employment with a safety lamp. Lamps are not to be allowed to burn when the gas fires in them.

The deputies, at the close of each day's work, see all the men and boys out of their respective places of work, and examine that no lights are left in the pit, that the doors are closed, and that the ventilation is in good order.

The duties of the subordinate officers and men, in relation to safety and the safety lamps, are generally printed for general information. They are affixed to doors about the mine, but are commonly known almost by heart amongst the workmen. In several instances they are sufficiently detailed, and sufficiently published; but, as there is no binding law on such matters, there are many mines very deficient in such public rules, more particularly in other mining districts—in truth, while the discipline of many mines in the north is excellent, it cannot be said of collieries in general, that any adequate system of discipline is established or carried out. Some admirable rules are to be found in print, in parliamentary reports, and in separate papers; but I fear they are not very generally known or observed. I have now before me a perfect list of rules of this kind.

HABITATION OF PITMEN, AND PIT VILLAGES.

The homes of the pitmen are erected either by the proprietors of the colliery, or by companies, who speculate in the building and letting of them to coal-owners, at from £3 to £4 per annum. As it is requisite that the houses should not be distant from the pits—houses and pits are often simultaneously abandoned, and the place presents a most desolate appearance. Of these cottages there are three kinds:—First, those containing two rooms on

the ground floor. Second, those containing one room on the ground floor, and a loft above. And third, such as possess two rooms below, and a loft above. At old collieries some extremely forbidding dwellings are seen—confined and dismal. In newer collieries they are far better, as at South Hetton; and in one instance, at Seaton Delaval, a colliery newly won, I saw long streets of houses of a superior character, and some of them, intended for the officers of the mine, were not at all unworthy of a higher destiny.* Taken generally, their habitations are mostly in "rows," and these again in pairs; their front doors facing each other, present a space generally clean, unpaved, and without drains or channels. The space between each two rows of back doors, presents along the centre one long ash-heap and dung-hill—generally the playground of the children in summer, with a coal-heap, and often a pigsty at the side of each door. Each row generally has a large oven, common to all its occupants; there are no conveniences. May not the filthy habits thus engendered, and ingrained as it were, operate in brutalizing the pitmen and their families? Would it not be better to conceal the ash-heaps, to provide conveniences along the backs of rows, and open greens for bleaching or playing, in the fronts; as, for instance, by arranging the village in triangles? Let each row have its front facing a triangular grass plat, and its back opposite to a similarly shaped ash-heap, enclosed within a suitably high wall, with conveniences let in, and with ash-holes opposite; the apices having gates for leading away the manure, and pointing to a six-sided common oven. Other geometrical figures might be used. A system of drainage (as Dr. Embleton, of Newcastle, who is familiar with pit habits, has suggested) is highly important, yet almost entirely neglected. I may add also a set of hot baths, as at once loudly called for, and easily got up in a pit village. In middle and advanced life, pitmen, like all hard-working men, exposed to alternations of heat, and also to damp, are very sub-

* The dwellings are the property of the proprietors, and their tenancy a part of the hewers' wages, and of other pitmen. Besides the house, they receive, for 3d. per week, as cartage, as much coal as they can burn. "Light come, light go;" and therefore they burn tremendous fires.

ject to articular, muscular, and neuralgic pains, and every colliery engine discharges regularly vast quantities of newly condensed steam into the "hot pond;" the whole of which, excepting what the sagacious housewife walks off with (hot and distilled, *i. e.*, soft water), to wash with, is allowed to cool! The remainder might continually supply a series of a dozen baths without any bath-waiters to fee.

As to the dwellings themselves, they seem faulty, inasmuch as both the pitman's two rooms always open directly into the open air, and have a communicating door, so that two currents must always make for the fire, one at each side; and the fires being always tremendously and needlessly large, these currents are so much the stronger; and, according to their power, must be the risk to a convalescent, on his or her first leaving bed.

Would it not be better, too, to have every two houses separated from the next two, by a passage from front to back? This passage divided opposite to the wall that divides the rooms; from the half to the front, might open the two front rooms of adjoining houses, and from the half to the back, in the same way, might open the two back rooms of adjoining houses. The division wall need not to reach the ceiling, unless by cage-work, neither need the front door (common to two houses), nor the back (common to the same two), be close topped, so that a high and thorough stream of air might pass. Each house might now have two-thirds of one or the other passage partitioned off by a wire-work door, for a larder, the want of which is now much felt. By washing in the back lobby, much mischief to convalescents (from the vapour) might be saved.

There is a very remarkable dissimilarity between the furniture and the cottages themselves, especially in the old collieries. So great a contrast could not, I think, be elsewhere observed amongst any class. Amongst several hundreds of pitmen's houses which I visited, there were few that did not exhibit this contrast. I allude to the comparatively showy and costly character of the furniture of the cottages. An eight-day clock, a good chest of drawers, and a fine four-post bedstead—the last two often of mahogany, and sometimes of a very superior kind, were

to be commonly observed. A newly-married couple consider these things as indispensable, and will begin life by a debt for these, which will be paid for by instalments, and of course dearly paid for. I have seen some chests of drawers, and some four-posters too, which even Mrs. P—— might be proud of, for the spare bed-room at Pitville. Sometimes you will see in addition, a "desk-bed" of nice make, for the children. The bedding is generally very good, even when it is upon the floor of the attic, where the younger children of a large family must sleep.

The pitmen have an unlimited command of small coals, which they can get as they want them, by merely paying a nominal fee for carriage to their cottages. They may be said to pay nothing for coals, consequently, they keep up fires large enough to roast an ox. Pleasant things are these immense fires on a cold night, after the needful ablutions.

This leads me to ask your company home with the pitman, after "losing time;" and thus we shall see something of how

> The pitman homeward treads his weary way,
> Glad to behold the faintest light of day:
> To change his garb, and sit beside the coal
> He help'd to dig from yon tremendous hole.

EVENING IN A PIT-VILLAGE.

Let us stand at bank, and see the shifts of colliers come up. Let us watch the old hewers coming up in fours and threes, and the putters and big lads huddling on the rope.* There, this time, you see a lot coming up, hanging like a string of onions on the rope-end—the little lads sitting on their fathers' knees; and see, there's one poor little boy asleep! How striking an instance of confidence in his father's tenacity! That little fellow has fallen asleep while coming up nearly a thousand feet! "Now, my lads, let's gang hame;" and away they start, after having un-

* I select an old pit, with the old mode of ascent. At present, and in all newer pits, the cage is used. This cage is an iron machine, descending on four upright iron posts or rails, and in fact, the effect is that of a vertical railway—the men sitting still in one compartment.

looped their legs, and stood upright at bank a minute, by which time the little sleeper awakes, and puts his black little hand in a bigger black hand, and away they trudge homeward.

From the different hours of work for different persons, all the men and boys do not return at once, yet a considerable portion will be found up at the bank about five or six o'clock in the evening. Trios, or long strings of these semi-blackamores may now be seen approaching the village from the site of the colliery, towards their own "Shiney-row," * as pit villages have been called by the men. You may see them carrying bottles, emptied of their cold tea or coffee, and bags collapsed by vacancy—some come swinging Davy lamps about; but these are few, as the lamps are commonly taken care of below in the pit. Whatever they carry in their long and oddly hung arms, you may know them to be pitmen, and by their gait and bend may form a shrewd guess as to their kind of labour. A hewer will be distinguished by his incurvation of body, inclining to the shape of a note of interrogation. His legs will have a graceful bow, only it will be in the wrong direction. His chest will protrude, like that of a pigeon. His eye will have the glance of a hawk half-awake, and his face somewhat the look of a pound of pit candles. The lads look either gawky or slouching, or daring and careless; but, poor fellows! they have all had enough work, and I ought not to criticise them.

Upon their entrance into their little cottages they proceed to strip and wash themselves, which, from the secluded character of the colliery villages, they see no harm in performing somewhat openly; but they haven't much private room.

Thus, as to time, the hour of retirement with artisans and mechanics in towns and cities is to colliers the hour of washing. It is as well to know this, when you are passing the pit village at this time, if you have any dislike to soap-suds, which are now repeatedly ejected from the doors. Washing done, eating commences; and, as I have already stated, there is no deficiency of

* The best houses in a pit village are occupied by the superior workmen, such as the overmen and deputies, and such a row of houses is sarcastically styled "Quality-row," or "Shiney-row."

animal food, and little luxurious accompaniments. One of these side dishes, or a second course, used to be, and sometimes now is, a "singing-honey." This is a rich kneaded cake, which has its name from the hissing noise it emits while baking on the "girdle" or gridiron. In olden times the "singin-hinnie" (as they pronounce it) was quite indispensable.

After taking a tolerable share of the good things set before them, the majority turn into bed, having to get up so early to work again. Perhaps you may see them again later in the evening, indulging in a slow sauntering walk, or a whiff of tobacco, or a scrape on the fiddle, or a blow at the flute, or a walk with a lass, or a wife, or a child.

The lads and boys are now generally returned from the pit, and the majority of the working people are now at home. The youngsters will soon wash, and then contrive to obtain a tolerable meal, perhaps a very substantial one. In several instances, however, the younger boys, who have not become inured to the pit, experience a want of appetite and a painful aversion to food, which nature usually overcomes after long habit and presence in the mine. I regret to say, however, that some children never wholly lose nausea from pit work. Now, then, the washed and stuffed boys are seen to get a short game or two at play, just outside the doors, and the elder lads a lounge in the lane or field, and to take a turn at pitch-and-toss, or some less innocent amusement.

A very short evening, however, will be that of the pit population. About nine o'clock, perhaps, fiddles begin to sound very inharmoniously; if possible, far more so than before. Attempts at quavers on the flute now begin to fail most suddenly, and familiar tunes become painfully slow and drawling; lads have lounged in from the lanes; poor persecuted dogs and donkeys have peace, and are voiceless; boys of all temperaments have become considerably less pugnacious; the tea-meeting at Tom Jackson's, and the week-meeting at Johnny Wilson's, have all terminated. Now, on every side, there are unequivocal signs of settlement for the whole night. At about ten or eleven o'clock, nearly the entire colliery village is quiet or snoring. You have

now, if awake, only the stars to gaze upon; if, however, you are near an eminence, pray, step up and look over the neighbouring country, and see the pit heaps of small coal blazing in all their brilliancy. There is enough coal burning, perhaps, within a mile or two of you, to warm half the poverty-stricken houses of a town. The pit fires at night are very striking. I used to spend many of my evenings in the pit villages, for the sake of pursuing my investigations into the condition of the colliers. I would go from house to house, talking with one and asking questions of another, until the people became familiar with me, and would say on my entrance, "O, it's only Maister P——; come in, Maister; wilt have a bit of baccy, or a pipe, or any thing like, Maister P.? Sit thee down, now!" I became accustomed to all the indoor customs and manners; could tolerate drowsy discords on miscalled musical instruments; could listen to remarks about meetings, either political or methodistical, or benefit club concerns. So I managed to learn the dialect, and acquired much minute information not otherwise attainable.

PHYSICAL AND DOMESTIC CONDITION OF PITMEN.

We might very naturally expect that the very unnatural situation in which the children employed in the pits are placed, and their exclusion from daylight and the open air, would materially influence their physical health; not only at the time, but would so affect their constitutions as to render them liable to particular forms of disease in after life. Nevertheless, my experience and observation amongst these people do not lead me to infer that any very pernicious effects result from these circumstances, in such numerous instances as to justify any thing like a general conclusion. I do not find them liable to any peculiar forms of disease in consequence. Consumption is rare amongst pitmen; scrofula certainly not more frequent than amongst other classes of workmen; though doubtless cases of this description sometimes occur, and the great joints are occasionally affected. Hernia is by no means frequent in youth; but we must remember that the employment of young boys is far from laborious. Older work-

men employed in hewing the coal, are not less liable to this complaint than other persons whose employment requires equal general muscular exertion. Most classes of labourers acquire a character in the gait and general aspect accordant with the nature of their occupation, and so it is with pitmen. As they advance in life, their knees and backs frequently exhibit a curved appearance from constant bending at their work; but this does not appear to have connection with disease of these parts. I have often felt surprised that greater suffering and disease should not result from the admixture of gaseous exhalations in the atmosphere of the mines; but these appear for the most part innocuous as to general health, though I have repeatedly seen cases of inflamed eyes from exposure to a blower of gas (the carburetted hydrogen.) That the health of the boys is for the most part good, is frequently shown in a remarkable manner, by their favourable recovery from severe wounds and other accidents. Nor do I believe that the growth and development of the frame is unfavourably affected. They generally exhibit a muscular athletic appearance, though thin in person, and often of pale complexion.

In the general condition of the pitmen, there are many circumstances which probably tend to counteract any injurious influence which the nature of their employment might otherwise exert over health. Amongst these may be enumerated the warm flannel dresses in which they work; the thorough washings of the entire person which they practise after the hours of labour, the situation of their houses, the plentiful supply of coals which they enjoy, and the ample means which they generally possess of providing sufficient supplies of wholesome food for their families.

The "outward man" distinguishes a pitman from every other operative. His stature is diminutive, his figure disproportionate and misshapen; his legs being much bowed; his chest protruding (the *thoracic* region being unequally developed.) His arms are long, and oddly suspended. His countenance is not less striking than his figure; his cheeks being generally hollow, his brow overhanging, his cheekbones high, his forehead low and retreating; nor is his appearance healthful; his habit is tainted with scrofula. I have seen agricultural labourers, blacksmiths, car-

penters, and even those among the wan and distressed stocking weavers of Nottinghamshire, to whom the term "jolly" might not be inaptly applied; but I never saw a "jolly-looking" pitman. As the germ of this physical degeneration may be found in the youthful days of the pitman, it is desirable to look for its cause.

The position of the hewer at his work is one of great restraint. There is an art in "*cutting*" coal; the occupation of "hewing" is therefore assumed at an early period, I believe at the age of twenty. There can be no doubt that a prevailing tendency through life, commenced at that age, will, in a degree, alter the natural configuration of the body; yet, previously to that age, we find nothing in the pursuits of boys employed in coal mines (*i. e.*, in "putting," keeping a door, driving a horse, and keeping a switch,) which can, more than any other occupation on the surface of the ground, either influence the growth, or determine the shape of the figure. We must look to other causes, in a measure, for an explanation of the bodily defects enumerated above. Pitmen have always lived in communities; they have associated only among themselves; they have thus acquired habits and ideas peculiar to themselves; even their amusements are hereditary and peculiar. They almost invariably intermarry, and it is not uncommon, in their marriages, to commingle the blood of the same family. They have thus transmitted natural and accidental defects through a long series of generations, and may now be regarded in the light of a distinct race of beings.

The duties of a pitman's wife are very numerous. The male part of her family* may be divided into "putters" and "hewers;" the former going to the mines when the latter leave; the hours of labour and rest are consequently not the same; thus there is entailed the necessity of preparing numerous meals, and at irregular and various hours of the day. Every man and boy immediately on coming from his work changes his dress, or goes to bed after taking a meal and washing himself from head to

* Families of *boys* are, amongst pit-people, valuable property, on account of their earnings in the pits. A widow with a family of boys is considered *a catch*. I was told that such a widow was accosted by a suitor even at her husband's grave. Her reply was, "You are *too late*: I am engaged. I accepted B—— before starting for the funeral."

foot. The flannel dress, also, in which the work is done, is washed; thus the woman is left with little time to attend to her duties as nurse, and the child is laid in the cradle and lulled into a state of injurious inactivity. No glittering and alluring toys are offered to it as incentives to play. At first nature speaks out loudly against this infringement of her laws, but at last yields the point, and habit becomes second nature. I may be allowed here to use the words of a writer whose language conveys more clearly and graphically the idea I wish to impart than any I am able to make use of. "To prompt young creatures to the required exertion, nature has given them an overflow of life and energy, as evinced in the ever-changing occupation of a child, in the quick succession of its ideas, in its jumping and skipping, and using all the modes of round-about action to expand muscular energy, instead of seeking, as in after life, to accomplish its ends in the shortest ways; and as seen among the inferior animals, in the play of kittens, puppies, lambs," &c. And I would add, that the gambols and incongruous movements, so beautifully dictated by nature to the young, with the view to increase muscular energy, and to promote the full and healthful development of the frame, terminate as they begin, at no definite point, and then the soothing and renovating influence of sleep steals over the child.

In visiting the habitations of the colliers you will find great distinctions in neatness, cleanliness, order, and general comfort of appearance. I have taken some pains to ascertain whether this was dependent most on the husband or the wife. Of course attention to household neatness and comfort must depend immediately on the latter; but an ill-conducted husband might render a wife indifferent and reckless in the management of household affairs, while, on the contrary, an untidy wife may render her home so little attractive and comfortless, as to induce the husband to prefer spending his time abroad at the public-house or elsewhere; my inquiries have led me to believe that the wife is more frequently to blame than the husband. Indeed, the women in the collieries are frequently remarkably ignorant and self-indulged.

cleanliness, both in their persons and houses, is a predominant feature in the domestic economy of the better females of this community. The children, although necessarily left much to themselves, and playing much in the dirt, are never sent to bed without ample ablution. Pitmen, of all labouring classes I am acquainted with, enjoy most the pleasure of good living; their larders abound in potatoes, bacon, fresh meat, sugar, tea, and coffee, of which good things the children partake as abundantly as the parents: even the sucking infant, to its prejudice, is loaded with as much of the greasy and well-seasoned viands of the table as it will swallow. In this respect the women are foolishly indulgent, and I know no class of persons among whom infantile diseases so much prevail. Durham and Northumberland are not dairy counties, consequently the large population (excepting the *hinds* in the northern part of Northumberland) are very inadequately supplied with milk. Did this wholesome and nutritious beverage more abound, probably the infant population would be more judiciously fed.

In all pit villages which I have visited there is a scarcity of milk;—so invaluable an article of diet, especially to children—so beautiful a prototype, as it were, of the future mixed diet of man—so admirable a specimen of what all cookery should aim at, (and indeed so far has unconsciously attained to, viz., the due admixture of the saccharine, the albuminous, and the oily principles)—cannot with impunity be totally discarded. The diet of a pitman and his family is altogether irregular, the receipt of pay once a fortnight, enabling an improvident family to revel for a few days in the richest and most extravagant food: after which (during the "baff-week" as it is called) they live mostly on tea and coffee, the latter well boiled, the former as carefully simmered, and both taken without milk; such beverages they generally take three, and even four, and in some cases that I have met with, actually five times a-day. Such a diet-roll must be injurious in many respects; and it might be matter for serious consideration how far such defects could be corrected.

Many pitmen have intelligent, industrious wives, who have served in respectable families; without "going to place," the

females are but too often ill-informed, slovenly, and of violent disposition. The improvidence and the extravagance in some houses would rouse the most indifferent. I have seen a huge girdle cake set edgewise on a table, leaning against the wall, from which each little urchin would help himself by tearing off what he wanted with his dirty hands; while the mother set an unopened parcel of sugar on the table, and tearing out a piece of the paper with her thumb, left each to thrust his or her spoon in at pleasure! What must, or can the effect of such training be? Many of their houses, on the contrary, are neat and orderly.

It is not uncommon to witness "*a cannie pit-wife*," after she has caused, by her severity, her child to cry, administering a little more chastisement to cause it to cease crying; and thus putting into practice an exploded therapeutical principle of curing *similia a similibus*. In short, the mothers seem guided in their maternal duties more by their instincts and passions than their reason. To say the least, they are persons whose minds are singularly warped by prejudices, and yield most readily to the dictates of superstition; their gregarious habits cherish and nurture these tendencies, of which their children are peculiarly the victims. Experience and precept are alike incapable of uprooting them; they grow with age, and become more dangerous in their effects. In the treatment of infantile diseases, for example, the medical man is more puzzled how to ward off the pestiferous influence of old women's nostrums and crotchets, than to neutralize the pestiferous miasmata that hang about the sick couch of the infant. Nay, old and young alike fall victims to these dreadful enigmas of uncultivated minds. Not the least remarkable circumstances in connection with these prejudices, are the sophistry by which they are sustained, and the bold and unblushing precedents which are manufactured impromptu, and adduced in their support.

As an example of superstition, I may mention that a medical gentleman in the county of Durham, was in attendance upon a boy who had in the pit received from another a wound in the back inflicted by a "*pick*," of so serious a character, that, for some time, his life was despaired of. The surgeon, after dressing

the wound was standing in the centre of the room, discussing, with the friends of the sufferer, the probable manner in which the wound was inflicted, and, seeing a pick lying underneath a table, he was proceeding to take it up, that the action by which the injury was inflicted might be demonstrated to them. "That is the very pick," said a grave old man, "with which the assault was committed." "Why is it here?" said the surgeon. "Oh!" said the man, "we wished to see if the wound would canker." "Then how," asked the surgeon, "will the presence of this pick assist you in making that discovery?" "If the blood on the point of *that* pick rusts, sir," replied the old man with much solemnity and emphasis, "the wound in *that boy's* back will canker, and he will die!"

A pretty strong belief still prevails in omens, warnings, and signs. The appearance of a *woman* (however well known) to a pitman, will perhaps prevent his going down the pit. A woman's draperies bode ill-luck to all in the pit that day. Presentiments are also regarded; but neither these nor the above so much in the north as in the other colliery districts of England.

COSTUME OF PITMEN—ANCIENT AND MODERN.

Railroads and provincial advances of civilisation have destroyed nearly all the romance of the road, and the march of intellect has found its way into pit villages. The queer and questionable things one hears of pit-folk belong mainly to the past; and in nothing is the course of improvement more than in a pitman's costume. What that is, or is not, in the pit while at work, I have already said. There, indeed, the uppermost covering is one of coal dust, which obscures every other; but meet the same persons above ground whom you have seen at work underground, and you would doubt their identity even if they were pointed out to you. Underground, you can see nothing but white teeth and red eyes in a mass of blackness: above, you find very decent-looking persons, of ordinary appearance at least as to dress. But it is on Sunday that the modern pitman is found to be most respectably clad. Then you meet him in full suit of black, with,

perhaps, a white neckcloth, and having on the whole a semi-parsonic air. You know him at a distant glance to be what he is; but you might guess the day by the dress of the man. Why they should select black is difficult to say, though I attribute it to the spread of Methodism among them, and to a certain imitative reverence for "local preachers" in that connection, some of whom I have known to be worthy men. This kind of dress is the very reverse of that which prevailed some forty or fifty years ago in those places. The pitman's holiday costume then, was a very gay and remarkable one. The oldest viewers and pit-folk can tell you something about it; but no such thing as a genuine specimen of it is now to be seen. In those earlier and merrier days, as traditions make them appear, the young pitman would wear his hair at the temples in curls, turning the hair round a thin piece of lead, inclosed in paper. These leads were only taken out at the end of the week, when the head was to be washed. Tails formed of the longest hair tied up with ribbons, and differing in length and thickness according to the fancy of the wearer, were at that period common to pitmen of all ages.

Next, the gay pitman would sport a very showy waistcoat, having striking flowery figures, and hence called his "posy vest." This would be displayed conspicuously. His nether man was clothed in breeches, either of velveteen or plush, which were fastened at the knees with different-coloured ribbons, hanging down or fluttering about in the wind. Stockings with "clocks," were the last thing towards the ground of peculiar appearance, and these were shod with stout shoes or laced boots. The gay man's head was covered with a round hat (like those odious things now in vogue), which, when the wearer was desirous of being very gaudy, also had its flowing ribbons. Thus arrayed, he would flaunt about, and boast himself of his physical powers, which he was ready to prove in reply to any kind of challenge; and on "pay-day," which happened once a fortnight, he was seldom content unless he had befooled himself with beer, and battered his foes with fists.

The games and sports prevalent at this period were rude and

disgraceful enough for the "Book of Sports" that troubled the old Puritans. I have been told that it was then dangerous for strangers to visit the pits and pit villages unprotected. A constable or man of law might be mobbed, or enticed down a pit, and kept there till his victim escaped. Travellers found the pitmen playing at quoits or bowls in the high-road. Nor was it pleasant to see an immense stone ball coming along the road to meet you at a fearful velocity. "Cuddy-races" or donkey-races, were very fine fun; and scarcely any poor animal escaped the sporting propensities of pitmen before they became Methodists, and decent gentlemen in black.

"STRIKES" OF THE PITMEN, AND STRIKING SKETCHES.

Most of the pitmen imagine themselves to be an oppressed race. They foolishly think that their interests and those of their employers are opposed. They believe that they have one effectual, and only one effectual weapon with which to meet their masters in the supposed field—or I should say, mine of contest—and that weapon is what they call a "*steek*," and what we call a "*strike*."

Five times within the last twenty-four years have these great interruptions of labour occurred, viz.:—in 1826, in 1831, in 1832, in 1844, and in 1849-50, entailing serious losses on all concerned, and injuring the trade and commerce of the whole neighbourhood. In the strike of 1844, the whole of the pitmen in the two counties of Northumberland and Durham ceased to work. The number of persons thus out of work equalled 22,000 men and boys, and upwards. It required a struggle, painful and severe, of four months, before all the collieries were again in full operation on the masters' terms.

The strike of 1832, was estimated to have occasioned a loss to the pitmen, in wages, of £80,000; and that of 1844, a loss of £300,000. In addition to the loss of the men, the loss to the coal-owners was estimated by themselves to have amounted in 1844, to about £200,000. In order to form an accurate idea of the total loss to the community, we must add to the above the

loss of wages to the numerous body of men employed about the pits and on the railways, in bringing the coal to the surface, and in taking it to the port of shipment; and the loss of freight and wages to all employed in carrying it to distant markets, as well as the injury to all persons engaged in the manufactures, commerce, and retail trade of the whole district.

The strike of 1844, was organized by the delegates of the "Colliers' Union," a combination which extends over all the coal-fields of the kingdom, and at one time numbered upwards of 60,000 men. The publications of the Union were written in a spirit of great hostility to the "master-class," and the avowed object of the Union was to stop all the manufactories of the kingdom, until they secured the rate of wages which they demanded for working the coal.

They attributed the failure of their enterprise in 1844, to having aimed at too much at once. Their present aim, therefore, is to produce strikes at individual collieries, selecting one at a time in each district; the men of that particular colliery being supported during their strike by the rest who are at work. It is supposed that they anticipate that the owner or master of that colliery, seeing himself thus insulated, his trade going from him, and all his fixed charges remaining to be paid, will yield to the demands of his men.

In this proceeding they have been partially successful—several of the collieries in Northumberland and Durham having recently submitted to their terms, rather than prolong a contest which would have occasioned a still greater loss; although at most of these collieries, at the time of their submission, neither the state of the work, nor the state of earnings, nor the price of coal in the market, justified the increase. Other collieries, however, have successfully resisted. Indeed it is now a general opinion, that no very long period can elapse before a reduction of wages throughout the trade will become necessary—this, if attempted, will most probably be followed by another general strike.

Now, of late years, such is the spread of dissatisfaction amongst the pitmen, that a kind of cycle of strikes and submissions seems to have been established. This is a most important feature in

the most extensive and valuable coal district in the kingdom, where some 25,000 pitmen (including boys with men) are employed.

The hinge of the whole question relating to masters and men in collieries, is of course, as elsewhere, the fair rate of wages which the profits will allow. I have already said something of permanent capital sunk, and profits reaped. I assume the general supposition to be true, that above £10,000,000* of capital are engaged in the coal trade of the two counties of Northumberland and Durham. We have to consider this capital as subjected every four or five years to an enormous tax by the ignorance, jealousy, and foolish cupidity of a majority of the pitmen. The complete throwing open of the trade to competition which has taken place in late years, has so diminished profits (according to the statements of owners and masters), that it is not able to bear such a burden. A great increase of joint-stock companies, associated for the purpose of working the coal, has been experienced within the last twenty years; and thus its price has been so reduced, that it is a matter of general complaint that the collieries in the two counties do not, on an average, pay more than five per cent. This was the remark made to me by the late Mr. Buddle some ten years since; and I should think it still more likely to be a correct view now. I have often heard those unconnected with the trade say the average is higher; but of course no one really knows except those concerned.

As to the pitmen's rate of wages in those counties, I think it cannot be fairly said, that they have too small a portion of the returns in the shape of wages. Let us look at the price of the best household coal delivered in the Pool for some years past—and it is as follows:—

For Five Years, ending	1832.....	28s.	per ton.
„	1838.....	24s.	„ (1833 excepted.)
„	1843.....	20s.	„
„	1848.....	16s.	„

* I take this supposition from a Commissioner's Report; and also from remarks in conversation. At first sight it appears too high.

Have the colliers' wages been proportionately reduced? No: while the price of coal has been going down in the London market 12s. per ton in the last twenty years, the earnings of the colliers *generally*, are as high as they were at the beginning of that period. When they are not so, they are lowered by their own voluntary restrictions on their labour, with the object of reducing the quantity of coal in the market, and thus forcing the price to rise.

It may very fairly be conceded to the pitman, that from the nature of his employment he is entitled to a very liberal rate of wages; and that the standard of his living and replenishment should be much above that of the daily labourer, especially in the open and fresh air. It may be also conceded to him, that he would be fully justified in combining to protect himself against any attempt on the part of his employers to depress him below that standard to which he has been accustomed, or to deal unjustly with him in any of the details of his work, in respect to weights, fines, and other particulars. But at the same time, it is manifestly a matter not only of the plainest duty on his part towards his masters, but of obvious discretion in reference to his own interests, not to resort to any extreme measures, such as suspending his own labour, stopping his employer's business, and thus throwing many others at the same time out of employment. Such proceedings can only be justified on the strongest grounds of right and justice, and after all other means of redress have failed. This, however, was not the course pursued in these counties. If the number of pitmen is redundant, it has been caused, not by the masters, but by the conduct of the pitmen themselves. Each of the five great strikes alluded to, as having occurred within the last twenty-four years, has been the means of bringing a great number of new hands into the trade.

In the year 1850, all the men employed at the steam-coal collieries and the iron works, have been able to earn 3s. 6d. a day throughout the year, clear of outgoings; while even during a preceding year, call d a "slack year," the earnings of the men employed in the house-coal collieries, have been at the rate of 14s. a-week throughout the year, clear of all deductions; and

in all cases, with cottage, garden, and coals in addition. At many of the collieries the men purposely restrict themselves; and will not earn as much as the owners might desire, by three or four shillings a-week. Yet, even at many of these collieries, the men had in 1850 struck, or threatened to strike, for a higher rate per *score*, although earning at the very time 3s. 6d. per day for five or six hours' labour. With reference to disputes about weights, fines, &c., it has been proved that the complaints were, in several cases, unwarranted.

A general strike in the pit districts results in a general turn-out, and according to the detailed description with which the late Mr. Buddle and a relative of his, favoured me, the whole scene must possess a certain kind of picturesque interest. The men on refusing to work, must of course evacuate their masters' houses. They were, on one occasion, seen to encamp in nomadic fashion along the skirts of fields and lanes, and a miserable life they seemed to lead without roof, fire, or "singing hinnie." No more comfortable rooms and firesides; but the favourite four-post bedstead, and the grand chest of drawers, stood either in the open air or half packed up for transport. Others found accommodation in public-houses, and placed their rougher furniture in the back-yards and outhouses, whilst the best articles were stored within. You might have seen three beds arranged in due position, and others preparing on the floor. In another public-house mattresses were laid all along the kitchen floor, and there was a room in which mattresses, and bed-clothes, and furniture, covered every foot of available space. When you mingled amongst the men, you might hear them complaining loudly of the cruelty and rudeness of their eviction from their cottages; forgetting that, if they struck work without notice, they would be evicted without notice, and that they who live in colliery houses should not throw up colliery work. On inquiry, it might be found that the length of notice which the pitmen gave of a strike, was met by the proprietors with an equal length of notice of eviction. You might, too, have been fully enlightened in all the mysteries of their alleged grievances in respect of the weighing of the coal. They would hew a tub of coal weighing six

cwt. for 2¼d., and would demand 2½d., upon the refusal of which they had turned out. Questions of this kind, always technical and uninteresting to any but those concerned, were the topics of dispute, and the grounds of difference.

The proprietors and managers had one only remedy in such cases, viz., the hiring of other men. In times of scarcity of men, of course they must accept the best that offered, and fine fun was it for the evicted hewers to cheer and taunt some tiny tailor, or straddling sailor, as he was conveyed past them to the office as a volunteer for the pits. You will readily conceive that pit-work would not suit every body; but now there is no deficiency of good pitmen, unless emigration should thin their numbers. I have often thought of late, that pitmen and navvies would make capital diggers at the gold-diggin's, as far as excavation is concerned.

The limitations introduced into the annual bond by which the men were hired, were constantly cavilled at; but, of course, they ought to have expected a strict interpretation of the letter. This bond is a very detailed and business sort of document, and leaves no loophole of escape. I had to study it, and to learn all about "laid out," and other colliery peculiarities, before I could make any thing of the disputes between master and men. The men, too, would always talk of these things first, and, if you were an ignoramus on these, you had small chance of eliciting much from them on other points of inquiry.

I trust that a better understanding will be the result of better education amongst the men, and this leads me to speak of that subject.

EDUCATION IN THE COLLIERY DISTRICTS.

We require to look back only a very few generations in the history of colliers, to find them just emerging from the greatest possible moral and intellectual darkness. The great merit of effecting this important resuscitation, must be entirely awarded to the Wesleyan Methodists. The untiring labours of this religious sect, not only imparted to the colliery population in the

North of England a higher tone of moral feeling, but, in their efforts to instil religious principles into their minds, afforded them, through Sunday-schools, a slight amount of education, and an imperfect capability of reading. The absence of education in the parents, is a certain guarantee of its great impeffection in the children. In the present generation, therefore, we see the imperfect ripening of the first seeds of education sown in a barren soil. It would hence be vain to look in this day for the hearty co-operation of the parents in the education of the children. The march of intelligence, the extensive use of machinery in the working of mines, and the admixture thereby with pitmen of a very enlightened class of mechanics and artisans, and the superior education of viewers, have been some of the many causes by which a better provision is made, in the present day, for the education of the rising generation.

The population of collieries varies from 700 to 3000; yet few collieries are provided with proper school-rooms, although nearly every colliery has one or more schools of some kind. The buildings used for the purposes of tuition are generally dwelling-houses or chapels, and it is not practicable for a teacher in these buildings to instruct his pupils upon the monitorial, the simultaneous, or the intellectual system. These chapels, as well as the dwelling-houses, are generally the property of the coal-owners, who exact no rent from the teachers; but when the chapels are the property of a religious denomination, the teachers pay a fair rental. It rarely happens that a person is allowed to teach at a colliery without the consent of the agent. The teachers in general have not received an education qualifying them to be successful teachers of the young; many of them are disabled workmen, and others teach for a few months of the year, and work in the pit during the other months. Their information is very limited, of which the more intelligent pitmen complain much.

The books used in colliery schools are, generally, Reading made Easy, Markham's Spelling-Book, the Testament, the Bible, and Tinwell's Arithmetic. The schools are often without maps, and books on geography. Education is not presented to the children in an agreeable or proper manner, and, owing to this

and the severity of the discipline, the children prefer labour in the pits. Very few of the pupils in the highest class at a colliery school can read with any degree of fluency, or give the meaning of what they read. The school fees are from 3d. to 8d. weekly, and the emoluments of a teacher are not equal to those of a labouring man.

There are Sunday-schools at each colliery; but these are not numerously or regularly attended, and they are conducted by workmen who have not the opportunities of mental improvement which are enjoyed by teachers of Sunday-schools in towns.

The state of education at the collieries has long been matter of regret to many excellent persons; but the early age at which the children went to work in the pits, the number of hours during which they were daily employed, and the unfriendly feeling which subsisted between employers and employed, presented serious obstacles to the education of the children, and no efficient measures have been adopted by the friends of popular education for instructing the colliery population. The coal-owners and their agents have long expressed a desire to promote the education of the pitmen's children; but consider that no efforts on their part would be attended with good results, and that they must wait till the men desire their aid. But few of the coal-owners subscribe liberally to the funds of a colliery school.

Taking into consideration the number of men that are employed at each colliery, the wages they receive, the noble feelings and heroism they display when explosions or accidents take place, and the proofs of filial affection which they exhibit; it might be supposed that they could be induced to join in some efficient plan for their mental improvement and the education of their children, and such undoubtedly would be the case if proper opportunities were given to the pitmen of knowing by what means these objects could be attained.

The mental improvement of the pitmen and the education of their children could be promoted at their own expense. At the greater number of collieries there might be an infant school, which would receive the children between 2 and 5 years of age; a day and evening school, in which boys and girls above 5

years of age would receive instructions in reading, writing, arithmetic, geography, &c.; and a girls' school, in which the girls would be taught sewing, knitting, &c. There might also be a library, containing cheap and useful books; and lectures might be delivered at regular intervals during the winter, on popular and interesting subjects. A small weekly subscription on the part of each workman, would raise a fund sufficient for the remuneration of all the teachers and lecturers, and for the providing of books for the schools and library. In return, the colliery population would possess excellent schools, accessible to all the children, and the adult population might acquire useful scientific instruction. The schools, libraries, &c., would require to be managed by a committee, aided by the agent and clerks. The workmen might be formed into an educational society, and elect the committee.

The pitmen at Killingworth colliery having had their attention directed to an efficient arrangement for education, expressed a desire for schools upon such a system. Nicholas Wood, Esq., the manager of the colliery, entered readily and cordially into their views, and the owners of the colliery readily agreed to provide schools and to give the society their support. Three large schools were built, one of these an infant school (and the first infant school that has been erected at a colliery in this district). These schools were opened in August, 1840, when 406 of the workmen had become subscribers of 3d. weekly to the schools, which are conducted partly on the Edinburgh Sessional System, and partly on the National System; but, as was stated officially at the opening of the schools, with a sacred regard to the rights of conscience, and to the progress of the scholars. Previous to this arrangement there was only one school at the colliery, which was attended by about 90 pupils; but the number at the opening under this new arrangement was 528, and the schools are in a flourishing state. There was therefore an instantaneous increase of above 400 in the number of scholars, and these not drawn from other schools, but from passing their time idly at home.

Lord Ravensworth, the Earl of Wharncliffe, and J. Bowes, Esq., M.P., are the owners of Killingworth colliery, and they are

well known as patrons of learning. Many of their workmen were born on the colliery; their pitmen seldom remove to another colliery; and Mr. Nicholas Wood, the manager, has not had occasion during the long period of his superintendence to require the aid of a soldier or constable; and yet only ninety of the children belonging to such a colliery attended school, while the schools are now attended by nearly 600 children, without the slightest inconvenience to the manager of the colliery. It may therefore be safely assumed, that the pupils at colliery schools in this district might be increased in a sixfold proportion.

These circumstances may lead to the conclusion, that if proper measures were adopted for imparting information to the colliery population of this district, respecting their mental improvement and the education of their children, they would become alive to the evils of ignorance and to the blessings of education; and would, under the auspices of their employers, form themselves into educational societies, so that all employed might increase their store of knowledge, acquire a scientific as well as practical acquaintance with their occupation, and secure to their children an extended and useful education. The subscription being small, the arrangement would prove of great advantage to those with large families, and would be oppressive to none; while it would secure scientific information to persons employed at collieries, which they could not otherwise obtain but at a great price and sacrifice of time.* It does not appear that the owners of the collieries, or the friends of popular education, will adopt adequate measures for promoting education at collieries without some new and stronger impulse than at present exists.

In connection with the boys' school at Wingate Grange colliery, a striking example of the peculiar jealousy and independent pride of pitmen may be adduced. The owners, anxious that the education of the boys should be as much an act of benevolence as possible, professed to exact only one penny a week from the men as an acknowledgement, and subsequently became very lax and indifferent in this exaction. The schoolmaster also was a man of superior education and gentlemanly address; a design appeared in all this. An under clerk, possessing physical defects, was dis-

charged from the service of the colliery; he established a school in the Methodist chapel, and in six weeks obtained 70 pupils at the usual rates of charges—sliding between 2d. and 6d. per week—the owners' school having diminished in this time nearly in the ratio of the increase of the other. This person possesses the usual qualifications of a pit-village schoolmaster, and is, doubtless, desirous of effecting good; but neither his ability, nor his system, can for one moment be compared to those of his competitor. Thus, evidences of the jealous and independent feeling of pitmen, exercised in reference to gratuitous services, daily present themselves, whilst they are, by craftiness and cunning, evading payment for services they have the appearance of purchasing. An additional instance of improvement in the arrangement and character of a school might be supplied from Urpeth colliery, under the management of Edward Boyd, Esq., who has been instrumental in making excellent provision for the education of the children.

In most of the larger and more recently established colliery villages in the county of Durham, and in many in Northumberland, spacious and otherwise healthfully constructed school-houses have been built; and here the owners and viewers devote as much attention, and afford as much encouragement to education, as may be reasonably expected from them. In the county of Durham, the owners of several of the large collieries themselves, remunerate the services of the schoolmaster; the salary and perquisites, they allow, being sufficient to engage the services of teachers in every respect competent. To speak generally of collieries, however, both in Northumberland and Durham, it must be admitted that the schools in use are little more than asylums, in which children too young for work are kept out of harm's way, and submitted to a rude discipline, which may, in some degree, suppress the growth of the more prominent vices, if it does not contribute positively to their moral culture. The schoolmaster, whether viewed in a moral or physical light, is, to say the least, a very insufficient instructor—his great physical incapacity, in most instances, neutralizes the little good that is in him. He is, generally, one from the people themselves, reared

up with some bodily infirmity, inherited from his birth, or the result of some disease or accident met with in early life, which has rendered him unfit for manual labour. The very causes which have brought him into his present occupation have been unfavourable to the growth and invigoration of his intellect. He is, consequently, found deficient in qualifications which he pretends to possess. His education is very meagre; and his mind has been little used to that orderly and consecutive manner of thought which is necessary for a teacher.

The individual encouraged to assume the office of teacher is often not a man whose conspicuous mental aptitude evinces his eligibility, but one whom accident has rendered incapable of bodily labour, and had reduced to the condition of a pensioner, claiming, from the mutilation or absence of a limb, to be the recipient of the bounty of the benevolent. It is not seldom that a disabled pitman proposes himself as a candidate for a schoolmastership; and should a vacancy occur in the colliery where his misfortune happened, he deems himself, and is deemed by others, indisputably entitled to the suffrages of all parties. This evinces sensibility to the claims of misfortune, and insensibility to the claims of education.

It cannot, therefore, be greatly wondered at if the ordinary schools be ineffective, many of the masters merely tolerated, and the dull round of duties dragged through, by the instructed and the instructor, as a burdensome yet inevitable task. Nor can it be a matter of surprise if thoughtless boys should frequently prefer the gloomy liberty of doorkeepers in the pit, to the uninviting subordination and rigorous discipline of the school-room. As to infant schools, I found but one or two in the whole district, and they are denominated "dame schools."

What are denominated "dame schools" partake somewhat of the character of infant schools, but the resemblance is chiefly traceable in the lowest point, that of their forming a secure receptacle for children whose presence at home is inconvenient. These schools are at least desirable counteractives to parental indulgence, and it occasionally appeared that the children derived some benefit from their attendance, when the preceptress tempered her

authority with an approach to maternal solicitude. But, as might be expected, this personage was frequently found to be one whose kindness, from infirmity of temper or age, did not flow in an expanded current.

The only means of instruction in any degree compensatory for the defects or absence of early education, are night schools and Sunday schools.

The demand for *night schools* by mining youths is trifling and inconstant, and hence the supply is similar. They are chiefly encouraged and frequented by the sons of the engineers and artificers employed at bank. Being opened by the same masters who preside over the day schools, and conducted under the same circumstances, they are liable to the same objections. The accomplishments which some of the masters declared themselves capable of teaching, were somewhat strangely contrasted with the apparent necessities and condition of their pupils; compound interest and plane and spherical trigonometry being often prominently professed. Occasionally an intelligent young man was met with at these schools; but the attendance of any class is usually so small and inconstant, that the teacher is in frequent doubt whether it be expedient to close or continue his night class. Such schools flourish almost exclusively in the winter; and even where the attendance of the scholars extends throughout the season, their cessation in summer nearly counteracts the benefits they may have derived from their winter course of instruction.

Nowhere did I find ventilation more desirable than in these night school-rooms. What with the roaring fire, the graveolent lads, and sundry other not very pleasant things, for myself I should have at any time preferred the atmosphere of the mine to those of the night school-rooms.

RELIGION AMONGST THE PITMEN.

As to religion, it has been shown that persons employed about collieries possess prejudices of a remarkable nature, and a credu-

lity which often sets the dictates of reason at defiance. It will not therefore be wondered at, that however great may be the excesses of pitmen, a religion is a very important and essential feature in the constitution of their social economy. In a colliery village of any standing, we find two or three dissenting chapels devoted to the various offshoots from Methodism—Wesleyans, Ranters, Kilhamites, New Connection, and Warrenites; sects which appear to differ from each other in points of government and doctrinal matters.

The dissenting chapels at collieries are well attended, and prayer-meetings are held in them during the week. In the county of Durham there are to be found most excellent clergymen of the Church of England, connected with churches near colliery villages, whose moderation exerts a beneficial influence over the minds of pitmen.

The church is sometimes distant several miles from the colliery houses. The circumstances that determine the site of a colliery village are necessarily independent of all reference to the position of the parish church, and are usually of posterior occurrence to its erection; while the localities of the chapels of the Methodists are decided simply with regard to the convenience of the pre-existing colliery village. Some of the parishes, too, are so extensive as to defy adequate personal superintendence on the part of a single clergyman; while, to employ the words of Archdeacon Allen, "out of every 100 clergymen, probably 20 at least, from some cause or other, will not be effective among a population so difficult of access." It will not therefore excite surprise to learn, that the presence of a pitman or his family in the parish church is, in most colliery neighbourhoods, a somewhat unusual occurrence. The pitman and his family then, resigned to the care of the Methodists, are generally unknown to, and unvisited by, the clergymen; and, as their own preachers are rarely resident, they are commonly unbenefited by the regular visits of any religious instructor. As in the extent of education, so in that of religious feeling, there is a considerable variation in different collieries, generally greatly in favour of those which are far removed from the perilous proximity of a town, and es-

pecially of a seaport town. In a few collieries some of the agents profess the tenets of Methodism, and exercise their influence in securing an attendance at the chapel; and in others, devout parents succeed in inducing their children to attend some of the services with them. But in the greater number of instances the boys, and especially the young men, spend the Sabbaths, as a lad of twenty years of age described himself to do, "in lying in bed or about home," if not much less innocently. The self-condemnatory answers of a young man of eighteen, and at a colliery, too, where the means of education are the most abundant, are brief, comprehensive, and characteristic of the conduct of the majority of his "marrows," when he states that he "goes to no school at all now. Takes all the rest he can get. Does not go to any place of worship, except once or so now and then. A good part go to worship; the youngest go mostly. He goes to walk. It takes all the week-end to fetch him about."

The Sunday schools are, in most instances, superintended by the various sects of Methodism; and it would be more desirable to allude to the zeal of the teachers than to their qualifications, at least for imparting secular knowledge. Yet, without detracting from the merit of efforts so praiseworthy and disinterested, and without overlooking the extensive obligations of pit-boys to them, it may very safely be affirmed, that the instruction derivable from Sunday schools in nowise atones for the early removal of the children from day schools.

I observed, both in this and other colliery districts, as well as in the mining districts of Cornwall, that the Methodists had been the pioneers in the path of religious instruction. This ought not to be forgotten; and chapels of various degrees of architectural pretension testify to the fact in nearly every pit village in the north. The Wesleyans are generally a comparatively respectable and well-conducted set of men. If one of the superior pitmen, as the overman, should be a good Methodist, it is a good thing for the colliery children. At one pit, Wallsend, I found a very excellent man, known through the Methodist connection, who both preached and practised Wesleyan tenets, and taught the children in the schools on Sunday, of course gratuitously.

Such men are blessings to the pit villages; but they are rare. I found, too, some few excellent clergymen of the Established church, but they have little fellowship of taste with the pitmen. A religious pitman may be recognised by his books—a large family Bible, Wesley's Hymns, the Life of Wesley, and Bunyan's Pilgrim's Progress. A reading pitman will have no political books; but one or more mathematical works, picked up from a stall at Newcastle. A reading pitwoman will have the "Oracle of Fate," the "True Dream-Book," the "Art of Cookery," and, perhaps, the "Little Warbler," or some Newcastle song-book. I intended to give some specimens of the songs in the Newcastle dialect; but, after having extracted some, I find no one sufficiently worthy of quotation.

MORAL CHARACTER OF PITMEN.

Perhaps one characteristic of pitmen least to be expected is, a deficiency in *moral* courage. I do not allude to any fear of mining dangers, but to a lack of personal and mental openness and boldness. A resident medical gentleman said to me:—"As to the deficiency of moral courage, no class of men appear to be so inclined to injury and theft; yet so afraid to go to work openly and singly. They are, it must be remembered, recruited from the dross of society,* and often change their colliery. I would say that personal courage is seldom shown by a pitman of twenty-five years of age, or upwards; I have seen an able-bodied pitman faint away on being about to have a tooth extracted; and you can seldom abstract more than about a wine-glassful of blood without inducing syncope; and this too in the case of men who had previously been in the army or navy, and so on; and who, excepting their pit-work, were very similarly circumstanced to others in the village; as masons, joiners, and others, who were much as other men in these respects. Pitmen always seem to

* This refers to the additions to their ranks when new men are required in new collieries, where they are generally inferior in morals. In speaking of *vices*, I refer especially to these men.

me to be easily overawed by a much less numerous body of other workmen, by an unusually small number of police, and especially of soldiery. I have been told of a score of infantry and half a dozen metropolitan police having sufficed to keep down some 1500 or 2000 pitmen; a number certainly insufficient among iron factories or cotton-mills. The parties, too, whom the pitmen select for injury, seemed to me always to be such as were least likely to obtain redress; viz., the farmers, gardeners, and others in the neighbourhood, and each other, or such of the villagers as were unconnected with the pit. The property of the viewer and of the under-viewer was always held most sacred; I never knew it meddled with. Their want of firmness and of moral influence is no less manifest within doors, where, whatever may be the peculiarities of the husband on the one hand, or of his wife on the other, the difference is still so great as to authority at home, that she is almost sure to rule in every case; and this from no amiableness on the part of the husband. Should the pitman have any where to go, or any little business to transact, the wife must not only be there, but superintend, or even do it entirely. I am scarcely, perhaps, prepared to trace such peculiarities to their source, much less to assign the pitman's occupation as the cause. The mixed character and origin of the pitmen; their great want of even the most ordinary education; the lack of magisterial vigilance and power; and their being subject only, and that but imperfectly and in reference to their work, to the 'viewer' of the pit; their short period of toil (about eight hours generally,) and consequently their free and frequent opportunities to contaminate each other; the mode adopted of paying their wages in large sums each fortnight, so that they are necessitated to go in groups to the public-house to divide, where, with singular improvidence, the majority of them will leave the most of it—(a state of things that cannot be too highly condemned, nor too speedily put a stop to)—all taken together, go far to injure the health, starve the families, and brutalize the character of pitmen. A more or less partial cause, perhaps, of their want of nerve, may, in connection with the above, be looked for in their diet generally, which is exceedingly faulty."

VICES OF PITMEN.

The prominent vices of colliers are gambling and intemperance. The gambling consists in cock and dog fighting, bowling, card-playing, and chuck-penny. Each is often carried to a fearful extent. Instances are not wanting of a whole month's earnings of a man and his sons being staked on a cock, a dog, or a favourite bowler. The consequences of such profligacy are, whether in losing or winning, the same. Misery, destitution, and dirt, prevail where comfort and affluence might have been. Cocks and dogs are either bought or stolen, and are obtained at considerable cost or risk. The cocks are also kept at a great expense, being always in the hands of trainers. Drunkenness is not the worst, although a prominent vice in some pitmen; but amongst them, as amongst all other classes of labouring men, teetotal principles have effected most gratifying improvement. Drunkenness is not, however, an habitual vice in pitmen; yet in their periodical debauches they nearly make up for the daily omission. The pay-day presents the scenes of drunkenness and riot; and beer is the favourite beverage. This periodical intemperance is attended with several advantages over habitual intemperance; it inflames both mind and body less. Indeed, the extreme revulsion occasioned in the system by the excessive drinking on the pay-day, operates as an alterative. One fact is certain, that medical men find pitmen recover from injuries, which in the London hospitals are speedily fatal, or require instant and formidable operations for their cure. It can be shown that instances of successful surgery occur in collieries which are unknown in hospitals, especially the metropolitan.

As a *general* observation, pitmen are temperate; drunkenness is the exception. Beside other large industrial districts, their morality *now* stands high. Crime in our metropolis is four times greater in proportion than in the mining districts. The cotton and iron districts much excel these in crime. From minute examination, I conclude that it is not education but isolation that produces this result in their favour.

Petty deception is practised to a great extent by pitmen. It is extremely difficult to find out their real sentiments. They appear to regard trickiness as an indication of shrewdness; for it will be practised with *eclat* upon a superior in the face of a whole community. Indeed, it would appear that deception is so much a practice with them, that they deceive when no earthly advantage can be obtained by it. A person in a higher station connected with a colliery, may be a dupe to constant schemes and tricks, which he may be years in discovering. Of course, honesty is not compatible with such a character; and yet a person residing near a colliery may never lose any thing of great value. Pitmen dispense charity largely, although most indiscreetly. A person with a clean white apron and three small children at his side, singing a hymn in a pit village, will be loaded with alms. They delight much in all things which excite curiosity. They magnify all misfortunes.

Their habits are not favourable to chastity. Their manner of living is very promiscuous. The houses being small, and the families generally very large, most unsuitable companions are found sleeping in the same apartment. The necessity for so much ablution, also makes the inmates of a cottage familiar with spectacles which are not quite so decent as they should be; although in the collieries in Wales very much more primitive scenes may be witnessed. Illegitimate births are not of unfrequent occurrence; such indiscretions are in collieries more frequently compromised by the voluntary acts of the parties, than in more widely connected communities.

On the condition, conduct, and treatment of females, I only observe that many matters which would come under this head have already been incidentally mentioned. It only remains to say, that in the family of a pitman they receive kindly treatment, and such generally as their sex would require. In their habits they partake much of those which prevail in the house; cleanliness and sobriety are much more common traits than the reverse. The young are more feminine than females in a manufacturing community.

THE ECONOMY AND FORETHOUGHT OF PITMEN.

As to *economy* and forethought.—The economy of a pitman consists in obtaining as many good things to eat and to drink as his money will immediately purchase, and as many more as the seller will give him credit for. A pitman who has a large account with his shopkeeper or professional man, at the next "binding" takes a remarkable aversion to his situation, and seeks employment at a distant colliery. It is a common practice for shoemakers and tailors "doing business" with pitmen, to receive payment for articles of clothing supplied, by instalments of 2s. a fortnight, and these often irregularly paid. The tradesmen complain bitterly of this practice, because they know it is unnecessary. A little economy, with the very large earnings of some families, is all that is required to enable the pitmen to pay ready money. The birth and the death of a child equally entail convivial expenses to a very large amount. The medical attendant who is concerned in both events, is always very pressingly and considerately invited to partake of the good things that are purchased with money, part of which should go in payment for his services. It follows that the credit of a pitman is not good, generally. Although in the power of many to do so, the instances of pitmen having saved money from their earnings are very rare indeed. If permanent infirmity overtake them, they are thrown upon the parish.

Of benefit societies under various denominations, both private and patronised by employers, there would at first sight appear to be no great lack in collieries and iron-works. In several of the collieries, I ascertained that many of the pitmen were subscribers to some species of benefit club, affording them in time of sickness such sums as 5s. or 6s. and upwards, to 7s. or 8s. per week; and in the event of death, insuring from £5 to £10 to the widow, or others, for funeral expenses, &c. Many of these sick-funds are merely temporary, and perhaps, in order that they may be adapted to those pitmen who are of migratory habits, dissolve with the dissolution of the annual binding, and have no

reference to any particular colliery. It is much to be regretted that the establishment of a general sick-fund throughout the collieries, does not appear to be feasible, or even acceptable to the miners themselves. An effort was at one period made by the owners to form a general, safe, and permanent society; and they proposed to tax themselves a halfpenny on each chaldron of coals sold, when the pitmen would subscribe a fortieth of their gross earnings. Their jealousy of the source whence the proposal originated, and their apprehensions of a design by this means to deprive them of a claim to relief from the poor-rates, rendered the pitmen unwilling to accede to the proposal, and the attempt consequently proved abortive.

At the time, however, of the great strike amongst the pitmen in 1831, they exhibited an instance of what unity in opposition could effect. The "Pitmen's Union," commencing with May 27, 1831, and concluding with June 23, 1832, comprised sixty-three collieries on the Tyne and Wear. The total income of the union was £32,580, of which £19,276 was paid to those who were out of employment, and £13,008 to the sick and for burials.

By far the most extensive society of this nature, connected with an individual concern, with which I was made acquainted, was that established in 1833, at the Countess of Durham's mines, and denominated the Lambton Collieries' Association; numbering at present 798 members. To this fund the Earl of Durham was accustomed to subscribe, and the Countess of Durham continues to contribute one-sixth of the entire amount subscribed, and from it the subscribers receive 7s. a-week in case of sickness, and consequent incapacity to work.

CONTRAST BETWEEN SCOTCH AND ENGLISH COLLIERS.

In taking as examples the best educated of both classes of colliers, the Scotch and the English, you are surprised to find so perceptible a difference in favour of the Scotch. When you enter some of the Scotch colliers' houses, you are not prepared for the choice of books you often find there. Many of them read such

books as Adam Smith's "Wealth of Nations," and are fond of discussing the subjects he treats of. They also read the lives of statesmen, and books of history; also works on logic, and sometimes mathematics. Such men can be reasoned with about any thing belonging to their calling, and they very well know why wages cannot at particular times be higher than a certain standard. They see at once, by the price current in the market, what is the fair portion to go to the workmen as wages, according to the circumstances of the pit, and the general state of the trade. Such men will have nothing to do with the Union. They scorn to read the penny and twopenny publications current in other places. They are ready, after their work, to read and enjoy a chapter of the "Wealth of Nations." They will also talk with zest of many of their great men—their own countrymen, who have raised themselves by their own industry. The reason that the Union is so strong in some parts of Scotland, as in Lanarkshire, is because in the latter place the pitmen are one-third Irish, and others are the worst of the Scotch, from other counties. I have always found that a bad Scotchman is a very bad fellow, a true example of the proverb, that *the corruption of the best things leads to the worst.* A bad Scotchman vinegarizes white wine. His natural keenness is turned into low cunning, and his propensity to selfishness is converted into the most engrossing self-seeking and indulgence. Much the same may be said of the Irish character; nothing can be finer than the original and genuine Irish character, and nothing much worse than its corruption and degradation. In the roughness of pit-life, all these points are more strongly observable in relation to national character, than in the more polished citizens of the factory and workshops.

Several of the best Scotch colliers have from time to time emigrated into the Tyne and Wear districts to earn English wages. But they do not spend English wages like Englishmen. Often rather than miss a good book they will go without a meal. The Scotchwomen, too, who in their own country are any thing but cleanly, begin to keep their cottages cleaner after they cross the border, and by degrees they keep them as clean as the

Englishwomen. And it has been observed that if they remain, the first generation after their fathers came, wish to keep every thing clean about them. They are generally very saving, and lay out the overplus of their earnings in books or furniture, or put it in a savings' bank or benefit society. The Scotch greatly desire to have their children well taught. The Scotch lads become manly in their habits, and their reasoning propensities are developed early.

But, on the other hand, the English pitmen who are readers and students are quite the exception. Adam Smith's works are a rarity. English miners seldom attack a book that requires steady thinking, or a work on logic, or mathematics (though *some* in the north pursue mathematics zealously). The Scotch often study both, and in such books as Watts' Logic, &c. The English do not often attempt grammar or geometry. They would rather read any such popular work as the "Christian Philosopher," the "Pilgrim's Progress" of Bunyan (deservedly a great favourite), or Walter Scott's novels. They like to read the history of their country, and they talk of its renown in the ancient French wars of Edward III. and Henry V. They are also great readers of the wars of Napoleon and Wellington, and what soul they have seems to flame up like the light of the Davy lamp, when they are in an explosive atmosphere of this kind. They are very fond of biography, and especially that of men who rose from poverty and obscurity to wealth and greatness. They delight in the lives of Ferguson, Franklin and the like; and the "Pursuit of Knowledge under Difficulties" is a favourite with several of them. "Uncle Tom's Cabin" will be a prodigious favourite with pit readers. There is, too, a kind of literature peculiar to the pitmen—the songs composed in their *patois*, or in the Newcastle dialect. Several editions of these in little volumes are sold at Newcastle. Of those I selected, I could scarcely find any rising in dignity to the rank even of a tolerable ballad; not one of them equals, I think, the poorer ballads in Percy's "Reliques of Early Poetry." They are chiefly useful to show the character, costume, and customs of the pitmen in former days, when they were a wilder and less decently behaved class of men.

But I must not be supposed to undervalue the possible improvement of English pitmen, in the observations I have just made.

How much excellent *substratum* of character there is *to work upon* in pit-folk, will be observable from what I have remarked of them in detail, under various heads. In truth, I believe that there is no such *materiel* in the world to work upon as the natural ability and natural feeling—the mind and the heart—of the lower classes of this country; for they possess quickness of perception, generous sentiments, and in the best cases strong religious impressions, or rather impressibility, a deep sense of right, an ardent desire for self-advancement, and a noble and heart-felt patriotism. You must *win* these as you *win* the coal. They are obscured, very often underlying much rubbish and useless superficial accumulation; but they *are* at the bottom, as the coal is, and it is just as much a science morally to study how these may be attained and developed, as it is naturally to study how the coal may be reached and worked.

Hitherto, most unhappily, little has been done for many localities. There is, for example, the parish of E——, in Northumberland, to which a one-eyed hack horse conveyed me in a very one-sided course from Newcastle. My advice to travellers is, never to hire a hack at Newcastle for the collieries, and never to ride in a colliery railway waggon. By the first I nearly broke my leg, and by the second nearly lost my head. Well, of this parish of E——. It is supposed to return to its landowners, without cost or risk on their part, not less than £30,000 a-year in mine royalties and "way leaves," and an immense capital has been laid out in the parish by other parties in raising coal. Now, when I was there, and up to a recent period, it had, I believe, only one clergyman, with a salary of less than £100 per annum, for the (nominal) *superintendence (oversight* would be a more expressive word, because capable of two meanings) of upwards of 10,000 souls! Were it not for certain sects of Methodists, little or no religious instruction could be given or received. What is the necessary consequence? Infidelity had become prevalent amongst many of the working men who were the greatest readers. A considerable portion of the young men were in connection

with no religious body, and were growing up with very slight notions of religion in any form. Can we wonder that, in such a soil, all the rank principles of unbelief, and unsoundness of thought as to all matters, flourish luxuriantly? Cheap and pernicious publications are the very things for these places. What can one unfortunate clergyman—or two or three—do there? With whom rests the blame? Not with the author.

We must avoid the conclusion, that all colliery parishes are equally neglected. There are several favourable exceptions. Those under the management of Mr. Charles Carr, near Newcastle, are worthy of mention. At the large colliery of Seghill, employing upwards of 700 men and boys, the men have come to see that it is their real interest to work steadily, and do a full day's work, instead of obliging the manager to employ more hands. They have recently been earning 4s. 4d. per day on an average, and working eleven days per fortnight. The men are reasonable and obedient, partly in consequence of Mr. Carr's management, and the residence of an intelligent and zealous clergyman. They have revived a decayed lending library, and it now consists of between 700 and 800 volumes, in a room opened two nights per week, and furnished with many of the best London newspapers, and some periodicals.

Sound principles of management have been adopted with like results, at the extensive iron-works of the Derwent Iron Company, in the county of Durham. These works are amongst the largest in the kingdom, and were commenced in 1841, and have collected on a high tract of moorland some thousands of souls. The manager, although baffled by a strike of all the colliers employed at these works, is of opinion that he has been amply repaid for all that has been expended with a view to the moral and intellectual improvement of the population.

ASCENT OF PITMEN IN THE SOCIAL SCALE.

GEORGE STEPHENSON—A BIOGRAPHY IN BRIEF.

In one sense, no men have more ups and downs in life than pitmen, and between more distant limits. A pitman who descends and ascends a shaft of 1000 feet depth, once each way *per diem*, experiences more ups and downs than a Stock Exchange speculator. But we are now to speak, not of ascending the pit-shaft, but the social ladder; and we propose to give a signal instance of success in such an attempt, by the late well-known George Stephenson, or "Geordie Stevy," as his fellow pitmen delighted to call him. I heard much of "Geordie" while I was a resident in the colliery districts; and, as I believe Geordie's life has not yet been written, I think it may entertain and instruct my readers if I give a brief sketch of it, since Geordie was, as they say, born and bred in a pit.

George Stephenson was born at Wylam, a colliery village of very primitive aspect, on Tyneside, near Newcastle, in the year 1781; and, as was usual with boys, was sent into the pit as a *trapper*, at the age of six or seven years. Imagine little Geordie sitting behind a trapdoor for ten or twelve hours of darkness, seeing nothing of the daylight above! He must be in the pit as soon as the work of the day, in carrying coals, commences; and, in compliance with the old system, he cannot leave the pit until the work of the day concludes. In winter time he must descend the pit before the Daylight ineffectually strives to gain an entrance there, and desists from the attempt a little way down the shaft. Geordie, therefore, only saw the light, in winter time, on a Sunday. In this employment his early years were spent.

When the coals are brought to the surface, boys are employed to pick out slates and dross from the pure coal; these boys are termed "*wailers*;" and a wailer Geordie next became at Wylam colliery, at wages of 4*s.* or 5*s.* per week. At Callerton pit he was promoted to the office of driver of a "gin," which is a horse-machine for driving coals. Geordie was found to be a steady

lad, and as regular as the horse at his gin; hence, when a pumping-engine was erected for pumping out the water from the mine, he obtained the post of foreman, at 10s. per week. From foreman he became engineman, and rose in general estimation for his trustworthiness and attention.

Why should not Geordie have a wife, now that he has the management of an engine? He is about twenty, and, though uneducated, he is a very "'cute and sonsy fellow." There was a respectable farmer's daughter to whom Geordie made love; but Miss Hindmarsh was too high for the poor engineman, and therefore he was left alone with his engine. Geordie, however, had resolved on a wife, and since Miss would not have him he descended one step, and asked her servant. The said servant had sense enough to accept Geordie, and a good wife she was. Had she but lived to see her son, the first of this union, Robert Stephenson, Esq., M. P., Engineer in Chief of the North-Western Railway, &c. &c.!—Had she lived to hear that son decline the honour of knighthood proffered to him by his Sovereign!—Had she but lived to see her husband, Geordie, the great engineer of his day, designer and maker of great railways, and honoured by nobles! She died, however; and, strange to say, Geordie again made up to Miss Hindmarsh, the farmer's daughter. This time she was wise, and became his wife; and *she* did live to see and share in her husband's honours and wealth.

At old Walbottle pit (near which I slept a night, in the subviewer's house), a breaksman was needed, to stop the drawing engine at the moment the coals were drawn above the pit's mouth. Geordie got the appointment, with 12s. a-week, which sum he at that time declared "made him a man for life." He acted in the same office at Willington colliery, at the ballast crane, and lived there for several years. It does not appear that he learned to read much before he was twenty-two or twenty-three years old. Education of the simplest kind was then rare in the collieries. In his after life he urged upon all young men to labour hard at their learning; and he was a zealous adherent of mechanics' and other educational institutions. At Killingworth colliery he again acted as breaksman, and remained some time,

making much progress in self-education. It was at Killingworth that I heard most of Geordie Stevy; and, if I recollect aright, the present eminent viewer of that colliery, Mr. Nicholas Wood, told me that Geordie was once under his command. Sundry relics of Geordie are preserved at Killingworth. While there he was attentive, active, and watchful. Being a man of strong native genius in mechanics, he made many minor improvements in the engine, the pumps, the pulleys, and in the general machinery, causing a considerable saving to his employers, and gaining high esteem and respect for himself. There the steam-engine appears to have been his study, and he gradually familiarized himself with its construction and capabilities.

In the steam-engine there is a something, as a journalist has well observed, which acts as a spell and a charm to the interested spectator—something more and something else than the love of a sailor for his ship—something beyond what the weaver feels for his loom, and the smith before his anvil. The smith or the weaver is the maker, the hammer or the shuttle works as his hand lists; but the steam-engine stands as if it had life and breath in it, working of itself, earnestly, steadily, and manfully —by day and by night, in its youth and in its elder years—when scores of men who worked with it have sickened and breathed their last. To the mechanic it is a thing of care and love, and its very form seems to give might to those who behold it, and to teach them the cunning and the ingenuity which lie in its own rods and pumps and cylinders. Thus, boys who watched it intently, have learned to strengthen it with cords of iron and slender rods. Thus, too, while a mere toy in the hands of Watt, it gained his affections, and claimed his life for its improvement. It grew to unwonted growth as his fame grew with its growth. In this manner, as if it had been a living child of princely origin, and destined to the foreseen sovereignty of the world of commerce—in this manner have man and boy, master and servant, nursed its childhood and gloried in its manhood; nor is it a small honour to colliers, that the Killingworth breaksman was one of its most manly and successful nursing-fathers.

We must not, however, forget Geordie's humble position in

our imaginative steam-enginery. He was a man of talent and industry. It is not often that we find genius and application, especially in humble ways, combined; but they were combined in Geordie, and that in no common measure. There were three breaksmen who took the "night-shift" or night-change of men, by turns. There was little real labour in the night-shift, which lasted about eight or ten hours. To draw loads up, and to let men down, was an idle kind of duty. The time therefore, especially at night, hung as heavy as the loads. Geordie, however, knew the great value of time, and was thrifty in its employment. During these night-shifts he learned arithmetic in a most laborious manner. Working his sums on a slate by the light hanging above his head, he sent the slate when filled to a schoolmaster in the morning, who corrected the sums, and sent back new questions for answer. Fourpence per week was paid to the teacher for this. When not employed in sums, Stephenson spent the night-shifts in cleaning the pitmen's clocks and watches for small charges. He made shoes, too, in these long hours, by the engine fire. It is even said that he could cut out cloth, and make clothes for the pitmen, and that he instructed the pitmen's wives in the art of tailoring. You may pick up singular anecdotes of this nature amongst the pitmen at Killingworth. He could turn his hand, head, and time to any thing; and amongst other relics of this early ingenuity is a sun-dial, still fixed over the door of the house he lived in while at Killingworth. They relate, that to the last day of his life he took a pride in this sun-dial; and that, not long before his death, when about to survey the line of the Newcastle and Berwick Railway, he drove a professional friend out of his way to have a last look at the dial, which had now indicated many days of prosperity since he made it in adversity and obscurity.

There was one very beautiful trait in the senior Stephenson's character, and it was his earnest desire to give his boy, Robert, that education which he himself had lacked. All the little money that Geordie could earn at clock and watch cleaning, and at tailoring and mechanical work of any kind, he devoted, after satisfying his bare necessities, to the education of Bobby. At

Bruce's school, in Newcastle, Bobby received a good elementary education. Geordie even sent Bobby to one of the Scotch universities,—that of Edinburgh. But of his attention to his boy's education he himself spoke at a dinner at Newcastle, not long before his death, when referring to his early career he observed:—"I have worked my way; but I have worked as hard as any man in the world, and I have overcome obstacles which it falls to the lot of but few men to encounter. I have known the day, when my son was a child, that after my daily labour was at an end, I have gone home to my single room and cleaned clocks and watches, in order that I might be able to put my child to school. I had felt myself too acutely the loss of an education, not to be sensible of how much advantage one would be to him." It is gratifying to know, that the success and well-deserved reputation of the son have amply repaid the care and self-denial of the father. Nor did the father depart this life without witnessing this success, and sharing, by sympathy, in the honours conferred upon his son.

Whilst Geordie was yet at Killingworth, about the year 1800, great distress prevailed in the country, and much privation was endured by the colliers. This was the period of the "dear years," as they are now called, when bread was scarcely purchasable. So straitened was Geordie at this time, and so dismal appeared his prospects, that he determined, with one of his fellow-workmen, to emigrate to the United States, where they purposed to try their luck at mechanics and farming. Imagine how much this project, had it been executed, might have retarded the railway system! What a change might this have produced from the present state of things! Suppose Stephenson had been a "Statesman" in America, then Chat Moss might have been uncrossed. The great locomotive factory at Newcastle, now known as Robert Stephenson's, might never have existed. The great North-Western Railway might never have been carried out. Locomotives might never have been improved, and Geordie Stevy might only have been known as a 'cute chap down West, and Bobby might have grown up into a thriving American farmer, or a Californian gold-digger! On what slight

hinges do great events and changes seem to hang suspended! But, in truth, these things are under an Almighty superintendence; and therefore Geordie went not to America, influenced, as poor mortals thought, solely by the affection which he bore to his kindred, and which bound him to home. But, as we *now* see, great ends were to be answered by the home-fondness of this man, and in this course events proceeded with him.

It is said that the simple incident which determined his homeward tarrying and his future fortune was this. In going to his work every morning, he had to pass a newly-sunk pit or shaft, which was much inundated, and from which men were ever drawing the water by pumps, but with very slow success. One morning Geordie paused, and looked in at the weary men and weak pumps, and observed aloud, that if he were employed he "would soon set them to the bottom of the shaft." Geordie was laughed at, and yet was so much respected that a trial was permitted to his skill. What the others could not do he did, and in a very short time the shaft was cleared of water. People asked who did it, and people answered "Geordie Stevy." His name became famous beyond the smoke of Killingworth, and Geordie was called in to cure all the wheezy, asthmatic, groaning pumps in the neighbourhood. Not only did he understand how to doctor pumps; but he now became well acquainted with the needs and capabilities of the steam-engine, and its better adaptation to pit machinery. So soon as pumps began to draw well, and steam-engines to work well under Geordie's care, he was consulted as an engineer, and gradually became a more prosperous man. What with putting up steam-engines underground, and mending those above ground—what with laying down tramways (iron railways for colliery waggons), and mending horse-gins, and doctoring boilers for steam-engines—Geordie was on the tramway to fortune, and gave up mending watches, making shoes, cutting clothes, and all his old practices, except brightening up little Bobby, who was become a strapping, thriving, 'cute lad.

It is not our purpose to follow Stephenson minutely in his career. Suffice it to indicate in brief his subsequent progress. His upright, manly, and highly-persevering character, procured

him many friends, and some very influential ones. Those who trusted him once with any difficult work, trusted him again; and thus Killingworth became a mere centre, round which his fame was widely spreading. He appears to have been still, and always a most zealous self-cultivator, always closely observant, always improving, always straight-forward and open-hearted. Yet even these qualities might not have advanced him so highly, had it not been for the concurrence of circumstances with his genius.

Steam had already become a great industrial power in England, and was doing the work of hundreds of thousands of horses. It had revolutionized the whole domain of human industry. It was driving mills and machinery, rolling iron, spinning cotton, grinding corn, and impelling ships through the waters; but the invention of the locomotive steam-engine, which was to bring cities together, to couple towns, and nearly to annihilate space, and to confer on man as much new power and enjoyment as if he were endowed with wings—this great invention was but yet in its infancy, or in its roughness; for at this time the locomotive was a rude and clumsy machine, and indeed much more of a curiosity than an efficient motive power. As early as 1804, Trevithick's engines were running on the Merthyr-Tydvil railway, in South Wales, and several years after,* one of the same engines was sent down to Wylam colliery, where Stephenson first saw it. He could not fail to be much interested in the new mechanical invention, and he seems to have directed all the powers of his strong mind to the improvement of this piece of machinery. He had soon planned a better locomotive, and to build it was supplied with money by Thomas Liddell, the present Lord Ravensworth, and by the other partners who were owners of Killingworth colliery, who seemed even at that time to have reposed in him the fullest confidence. In this engine he first adopted the

* William Chapman, the engineer of Newcastle, was the first who tried the locomotive engine, according to local belief. He seems to have tried it about 1805 or 1806, at latest. His little experimental engine was lying neglected in a corner, at Willington Ropery, a patent rope-walk of his, about the year 1811 or 1812. The wheels were slightly indented. He had no idea that weight and friction would give the wheels sufficient hold.

great improvement of double cylinders, Trevithick's engine having only a single cylinder, and being therefore in its action very irregular. Geordie's engine succeeded admirably, and he was enabled, by the assistance of his powerful friends, to take out a patent for it. Next year he erected his second engine with further improvements, and was also engaged as a coal-miner and engineer in laying out railways. His hands were now full, his prospects bright, and his friends numerous. To complete his joy, his son Robert, now no longer little Bobby, or Bobby the lad, had completed an excellent education at the university of Edinburgh, and had returned and joined his father as "under viewer" and assistant engineer. Both were engaged in various works and projects.

There is some considerable doubt whether George Stephenson may not claim the invention of the mining safety lamp, now called Davy's safety lamp. I heard a story to the effect, that his wife found Geordie one evening in a position very much to his and her dishonour, and no other than that, apparently, of a drunken man on the floor, in so much forgetfulness that he had actually turned the fender over, and put his candle under it, lying idly while the candle burnt against the net-work of the fender—for at that time most small fenders were composed of a kind of open work or lattice work which formed the front. Most persons will call to mind such fenders as having been used, especially in small rooms. But so far was Geordie from being drunk and disgraced, that he was at that moment in a profound reverie of a philosophical kind—observing that *the flame of the candle did not pass through the small apertures of the latticed fender, and gathering from this fact the rude idea of a safety mining lamp.* Whether the story be true or not, certain it is that Geordie got some crude notion of a safety mining lamp, and there seems to be no doubt that he had long been experimenting with his lamps at Killingworth, before Sir Humphrey Davy's discovery was made public; and that he had ordered his first lamp, and had tried it in the colliery, before any of the other claimants had brought their lamps to the test of actual trial in the pit. I found a general opinion prevalent in the district, that Stephenson

was the inventor—Mr. Buddle, indeed, the late eminent colliery viewer, expressed to me a contrary opinion, and he, I believe, received Sir Humphrey Davy at the time of his local visit. But the men of Newcastle in general have always strongly supported Stephenson's claims to priority of invention and employment; and in January, 1818, they testified their conviction of the truth of their opinion, by publicly entertaining Mr. Stephenson in the assembly rooms at Newcastle, and by presenting him with a silver tankard, together with 1000 guineas, being their testimonial to him as the "Discoverer of the Safety-lamp." It seems to me that the question of priority of invention cannot be satisfactorily settled; and it may have happened in this, as in several other important inventions, that some leading minds of men of genius were simultaneously engaged on this interesting subject, and were perhaps nearly simultaneously hovering on the brink of discovery. We must not too forget, that the claim of a townsman or fellow-craftsman is apt to appear stronger to us than that of a stranger; and this kind of feeling may perhaps prevail the more, the nearer we approach to Scotland. Indeed, I much wonder the Scotch have ever admitted that the safety-lamp was not invented by a Scotchman! Can any thing good come out of England?

We must not follow Stephenson much further; for he is not legitimately ours in this work when he leaves the collieries. I have seen one of his locomotives remaining at Killingworth: and although it is vastly inferior to the elegant little locomotives of his accomplished son, yet it is interesting to contemplate the first stages of improvement in so wonderful a machine. It is always a subject of boasting amongst the Newcastle miners, that their trams and their mechanisms furnished the thoughts and plans for railways, and this principally through Geordie. Railways gradually began to attract the attention of inventive minds while Stephenson was at Killingworth. In the county of Durham he himself was at work on the Stockton and Darlington railway, of which he was appointed the engineer. Though at first merely a coal railway, it was one of the first railways in England worked with the new locomotives; and the works for

these were commenced in 1822. George Stephenson now commenced a locomotive workshop in Newcastle, and this gradually increased to the great and flourishing factory, which I went over with astonishment and admiration, with an order from the son. They say he never ceased improving locomotives, so that he was enabled to outstrip all competitors. It was his engine, the "Rocket," which gained the £500 prize on the opening of the Liverpool and Manchester railway. Of this railway he was also the chief engineer. His triumph in crossing the pulpy Chat-Moss is well known. His fertility of invention was displayed in the ingenious idea of sinking hurdle after hurdle into the boggy plain, until he gained a firm surface. He was carried forward like one of his own engines by the steam that was in him—by the self-generated power of overcoming difficulties. As railways and locomotives increased, so did his gains and his fame; and finally the poor pitman of Killingworth, who thought he was made a man for life when his wages were advanced to 12s. per week, realised a large fortune—bought an estate, Tapton, in Derbyshire—opened and brought into demand the coals of midland collieries—mixed with all classes of society—and saw his son Robert becoming a great and a wealthy man before he died, at his own seat, in August, 1848, in his sixty-seventh year. "I may say," he observed, in an after dinner speech, "without being deemed egotistical, that I have mixed with a greater variety of society than perhaps any other man living. I have dined in mines, for I was once a miner, and I have dined with kings and queens, and with all grades of the nobility, and have seen enough to inspire me with the hope, that my exertions have not been without their beneficial results—that my labour has not been in vain." Such was the man, the original of whom was Geordie Stevy the trapper, breaksman, engineer, pump-doctor, locomotive engine manufacturer, and railway engineer of the earliest railways!

Conceive the thoughts that might have rushed through his mind as he stood, in his latest years, once more opposite his own old sun-dial at Killingworth! The sun-dial had remained as fixed as when he placed it there. The sun and the shadow had

passed over it as regularly and peacefully as when he was a poor man. But latterly, while the sun and the shade were daily passing over it in all orderly quietude, he was far away, engaged in the most anxious duties—cutting through hills, levelling eminences, raising valleys, erecting bridges, surveying in all directions—improving locomotives, planning new works, crossing rivers, making *terra firma* of quaking quagmires—catching glimpses of vast developments of the railway system—becoming a great man—consulted in all difficult cases that surpassed the powers of other men—looked up to by great men—honoured by the cotton lords of Manchester, and the merchant princes of Liverpool—buying estates—opening new collieries—going up to London to dine with the highest—having public dinners given to him—toasted, feted, enriched;—and yet, while all these wonderful and almost incredible changes had been going on, *there* stood the old sun-dial—the work of his own hands!—It had recorded the hours of all those days of prosperity;—it had not changed, like its fabricator;—it had marked all—it had registered all—and it had seemed to declare, with its smiling and sunshiny face, as the pitmen of Killingworth passed by—"Here am I, Geordie Stevy's dial; while I am noting the hours, he is rising up higher and higher in the social scale; yet Geordie will come once more and look upon my face—I shall have for him a smile of sunshiny welcome, and a shadow of grave admonition!" What an appropriate motto would it have been for Geordie Stephenson, when looking upon this dial—

"Tempora mutantur et nos mutamur in illis!"

There is not, probably, another instance of a pitman rising so high. If Geordie's life were well written, it would be as interesting as any life could be. It would furnish another striking chapter to the "Pursuit of Knowledge under Difficulties;" and it is a sad pity that it is not written in a popular style, to put into the hands of all mechanics, and especially all pitmen. What better companion for the boys and lads—the old men and the young men? What so sure to interest them—what so likely to benefit them, and stimulate them in their self-cultivation? If

the lives of Ferguson and Watt have been so beneficial to mechanics, surely that of their own Geordie would at least be equally so to pitmen! Why does not the accomplished, wealthy, and honoured son write the life of his own father, for working men? If he will only accept my most respectful suggestion, no one will be more happy to promote its circulation amongst the pitmen than the Author of this Work.

There are some few other instances of a striking rise from the occupations of the pit and its surface works to mercantile eminence. There is now living a partner in one of the largest manufacturing establishments in the north, who was once, I believe, a pitman, like Geordie Stevy. This gentleman may now (if not recently deceased) be seen in his counting-house, near Newcastle, behind his desk, directing the course of affairs in a very large concern. He is both grave and gentlemanly; and to him I am indebted, not only for courteous attention, but for many scraps of information not otherwise easily attainable. While sitting at table with him, he entertained me with minute and graphic descriptions of the state of the pits in former days, and with glimpses of his own early days and ideas. Having felt the need and benefit of education, he is a zealous advocate for, and supporter of, schools.

Amongst the gentlemen locally eminent in the north, might be found some of similar history; but this eminence being only local, we cannot properly introduce them into these pages, nor indeed do their biographies afford sufficient salient points. All have risen by the exercise of perseverance, unabated industry, and undaunted determination—qualities which might raise other miners to high, if not to equal, eminence and substance. If this little work should fall into the hands of pitmen (and the author would rejoice if it does), let them remember, for their incitement to imitation, George Stephenson, whose resolute, and almost heroic spirit, and indomitable perseverance, enabled him to overcome all obstacles of birth, position, and education. Let pitmen ever set him before them—toiling upward from his dark doorkeeping slavery in the mine, to be the great engineer, and the tamer of the fiery horse (the railway locomotive), which he at length rode at

almost lightning speed, and guided with the slightest reins, and turned with the gentlest touch. Let Geordie with his hard scarred face, channeled by winds and years, be ever before them—let them, like him, be diligent self-cultivators, hoarders of time in its minutest fractions—anxious for their children's improvement, and ready to do their utmost to benefit the whole human race, by industry and science.

We may add, that several men, eminent in different walks of life, have either risen from the pits or been associated with them in their early life and parentage. The late celebrated mathematician, Dr. Hutton, was originally a hewer of coal, and once employed in old Long Benton colliery. He was born at Newcastle in 1737, and at an early age undertook the profession of teacher, though himself almost self-taught. He conducted a seminary at Newcastle from 1760 to 1773, during which period he had Lord Chancellor Eldon for a pupil. He was a well-known author, and died in 1823. William Huntingdon, the eccentric but clever Antinomian preacher, was a coal-hewer. The "King of the Conjurers," as the ingenious Ingelby was called, was a pitman, and first practised the black art in the black regions of the pits. Thomas Bewick, the celebrated wood-engraver, sprang from a collier near Hexham, and was early immured in pits. "I have heard him say," remarks a friend, "that his remotest recollection was that of lying for hours on his side between dismal strata of coal, plying the pick with his little hand, by the glimmering light of a dirty candle."

HIGHER EDUCATION IN THE MINING DISTRICTS.

If, as has been estimated, no less a capital than *ten millions* is embarked in the coal trade of the two counties of Northumberland and Durham, exclusive of that employed in the several new iron works which have already risen into importance, then the whole question of elementary education in this great and important mineral district, deserves more attention than it has yet received. The frequent and serious losses inflicted on the great

mining interests by the ignorance and wilfulness of the colliers and miners in their combinations and strikes, and the burden, of no slight addition to their fixed capital, imposed upon many of the principal works, in consequence of their liability to those untoward occurrences, have already produced a general though inadequate effort to raise the intelligence and character of the labouring population. But there is still a wide field comparatively untouched, and a judicious dealing with this would impart a strong stimulus to the whole.

The number of collieries in Northumberland and Durham is about 140. In each of these there are on an average three subordinate situations of authority and trust, filled by men selected from amongst the most orderly and intelligent of the pitmen, making in the whole, perhaps, about 400 such situations in the district. Such men are the under-viewers, the wasteman, the overman, and the deputy. It is of the greatest importance to the employers that these persons should not only be thoroughly trustworthy, but should also possess a degree of knowledge and intelligence considerably above the ordinary level. For upon the right discharge of their respective duties depend, to a considerable extent, the safety of the pit, the discipline of the men, and the economical working of the mine. The higher their qualifications, the greater their ability to maintain their authority over the men placed below them, and to discharge their whole duties satisfactorily. Now, there is an acknowledged want of men capable of filling these situations, and no efficient means, I fear, have yet been taken with a view to supply their want. It is said that appointments to these situations are generally due to personal favour, and that there is in most cases a very imperfect security to the employer, that the duties will be properly performed. It might have been thought that in a district so compact as this, and where all the employers have in this respect only one common object, but little arrangement would be necessary to produce in a few years a numerous well-qualified body for the above situations. But this is not yet effected, for nothing always seems to mar every plan of concerted arrangement in this direction. You will hear constantly of what has been attempted

and is intended, but you will see little [illegible] beneficial result, and of practical operation. Schools, indeed, [illegible]ional and others, are general; but they do not seem to [illegible]e present or general effect. Perhaps we must wait [illegible]ly for this; and meanwhile go on and faint not, neither [illegible]y in well-doing.

It is a common subject of complaint amongst those employers who have made the greatest sacrifices in money and personal exertions to provide good schools, [illegible]h libraries, and encourage evening schools, and to obtain [illegible]s on useful and entertaining subjects, for the benefit of the [illegible] population, that the latter do not respond to these efforts [illegible] to any great degree—that the schools are ill attended—that [illegible]ildren are withdrawn from them at a very early age—that [illegible] circulating libraries are not used;—and that other means of [illegible]ion and entertainment are disregarded or squandered [illegible] their money away. Now, I believe this to be truly [illegible] on the whole, but the causes are, I think, [illegible]vious. The present [illegible] intellectual state of the adult [illegible], and the [illegible] entire [illegible] of any adequate stimulus to mental exertion, will account [illegible] much of the neglect complained of. The labour of [illegible] is unskilled; and their intellects being mostly dormant, [illegible]em to have nothing to gain by cultivating their minds. [illegible] there is any rich mental power, it will of course develop [illegible]self; but a stimulus is needed for the mass. What this [illegible]ulus should be, depends upon the circumstances of the colliery. I have often suggested, minor rewards for proficiency, but [illegible]ink the most effectual stimulus of all would be, [illegible] promotions founded on training merit. There is no lack [illegible] of instruction; but it is unfortunate that the [illegible] and privately provided are seldom brought to bear upon [illegible]ons actually needing to be benefited by them. [illegible]ple, a good college at Durham—the Durham [illegible] furnished with some adequate provision. Why should not there [illegible]ally useful establishment for the higher education of the [illegible] miners? Again, there is the Museum of Economic Geology [illegible] Jermyn Street, London, founded and supported by public [illegible] and having a fine museum and well-furnished laboratories [illegible] mining, mineralogical

geological, and chemical professors. I should like to know how many young men intended for overmen, and under-viewers, and managers of collieries, are to be found studying there. If a system of successive promotions for mining merit were established, surely the prospect of some four hundred good situations, all following in fixed gradations, and to be obtained only by qualified persons, would go very far to quicken the intelligence and stimulate the ardour of all young men in mining districts.

I have now presented as complete a view of the subjects of my Work, as the assigned limits have permitted. I trust that my readers will have derived useful knowledge, as well as entertainment from my labours, and that this little Work will, at the end of the traveller's journey, pass out of his pocket and find a resting-place in his library.

THE END

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